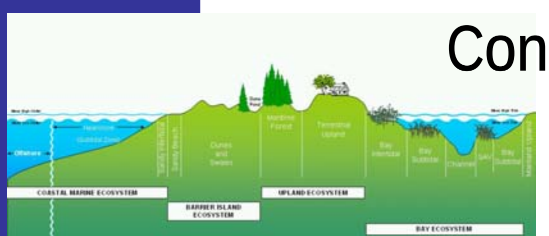
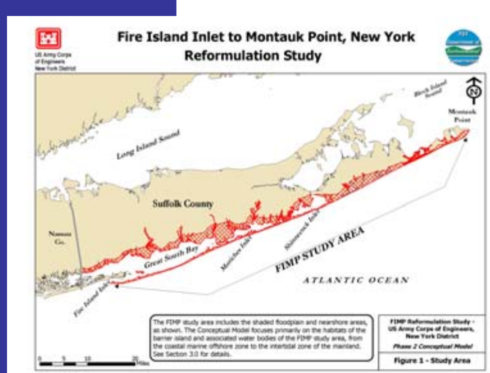
FINAL REPORT

Atlantic Coast of Long Island, Fire Island Inlet to Montauk Point, New York Reformulation Study

Work Order 38
Phase 3 Development of the Conceptual Ecosystem Model for the Fire Island Inlet to Montauk Point Study Area





March 2006

U.S. Army Corps of Engineers

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The US Army Corps of Engineers, New York District (District) is partnering with New York State Department of Environmental Conservation (NYSDEC) to conduct a comprehensive feasibility-level Reformulation Study of the shore protection and storm damage reduction project for 83 miles of the south shore of Long Island, New York, from Fire Island Inlet to Montauk Point (FIMP study area, Figure 1). While the FIMP study area extends 83 miles in length, the actual impact zones are larger. The Reformulation Study will result in recommendations that, if implemented, can result in a project that provides New York State and its residents with lower storm damage risks and a full range of future options for coastal zone management.

Consistent with the FIMP *Vision Statement* and ACOE's *Environmental Operating Principles*,the FIMP Reformulation Study takes an integrated ecosystem approach to maintain and restore essential physical coastal processes, particularly the hydrologic and geomorphologic processes, to increase storm damage protection and to reduce risks.

The assessment of alternatives will place a priority on restoration and management options, such as inlet and sediment management, that allow an ecosystem-wide approach. Included in the management options will be an evaluation of breaching response and closure policy as a means of storm damage reduction. Next, nonstructural component features will be evaluated, followed by structural features. Successful plan components will be combined to create storm damage reduction and restoration plans for the entire study area.

Federally-funded storm damage reduction projects must be justified by comparing National Economic Development (NED) benefits to the cost. The NED plan will identify the alternatives that provide the maximum NED benefits on excess of project costs.

A National Ecosystem Restoration (NER) plan will be also developed to identify a plan that will maximize ecosystem restoration benefits as compared to costs. The NER plan may make recommendations that do not optimize the cost/benefit objectives for storm damage reduction that would be part of the NED plan. The NER plan will be developed from the array of plans that meet the SDR objectives of the project. The plan will consider the ecosystem restoration benefits from restored physical processes and improved ecosystem function.

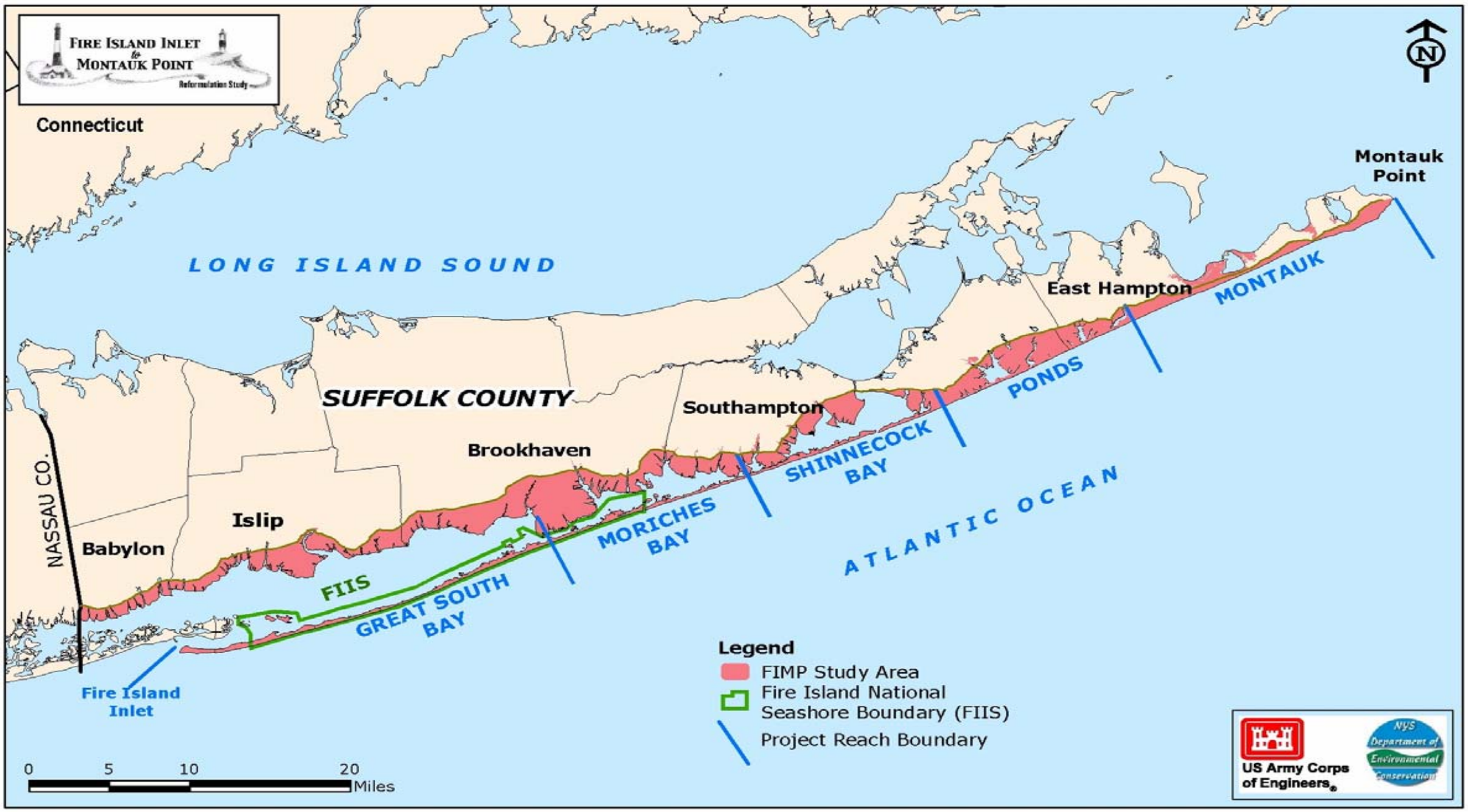
A combined NED/NER plan will be prepared that that meets SDR requirements while maximizing environmental restoration outputs by balancing tradeoffs between NED and NER outputs.

The District is formulating a plan to evaluate an expanded scope of possible features to address water resource needs within the study area. The plan includes:

- Identification and screening of features,
- Detailed design of protection by project reach,
- Design optimization and comparison of features, and
- Selection and final design of a recommended plan.

A critical step in the overall project is the development of site-specific information that will be used to evaluate each alternative in order to identify feasible plans of protection for each project reach. The study area is divided into the following five project reaches (Figure 1) based on considerations of coastal/geological characteristics, engineering, economics, environmental constraints, coastal zone management criteria, existing development, and local regulations:

Figure 1
Study Area
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point Reformulation Study



Fire Island Inlet to Montauk Point Reformulation Study Area:
Project Reach Boundaries

- Montauk
- Ponds
- Shinnecock Bay
- Moriches Bay
- Great South Bay

Scientific data were collected, analyzed, and peer reviewed to improve understandings of complex and dynamic, regional hydrologic, geomorphic, and ecological factors and interrelationships. These data also facilitated the building and sharing of an integrated scientific knowledge base of natural and socioeconomic data for the study area.

An Environmental Impact Statement (EIS) is being prepared for the feasible plans. As part of this process, the Conceptual Model described in this report is being used as one tool that will provide input to the EIS framework. The Conceptual Model is particularly valuable in assessing the environmental significance of the proposed alternative management options in each project reach.

1.1 PURPOSE

The purpose of the FIMP Conceptual Model is to represent the present scientific understanding of the ecosystems within the study area that could be impacted by the project. The Conceptual Model will also assess how the ecosystems of the study area are affected by on-going natural and anthropogenic stressors, in addition to environmental stressors relevant to the management features under consideration. Since the study area is comprised of a complex mosaic of habitats and ecosystems, the FIMP Conceptual Model is actually the composite of 18 habitat-based models (ie., 14 habitat models that fall within four ecosystem models) and 13 project feature-based models. The models are intended to describe the functional relationships among the natural biotic, abiotic (physical, geological and chemical), and anthropogenic components of the South Shore ecosystem in sufficient detail to assess the ecological implications of management decisions associated with the plan.

This Phase 3 Conceptual Model builds upon Phases 1 (USACE 2001) and 2 (USACE 2004) by incorporating models developed for project and restoration features. Phase 3 systematically incorporates the proposed features into the existing habitat-based model framework to facilitate an impact assessment in the EIS for each of the habitats. Figure 2 represents a flow chart of the development of the Conceptual Model, and how it interfaces with other components of the Storm Damage Reduction Study.

1.2 REPORT OVERVIEW

The scope of the Phase 3 Conceptual Model effort is based on existing information and the results of the Phase 1 (USACE 2001) and Phase 2 (USACE 2004) Conceptual Models and includes the components discussed in the following paragraphs.

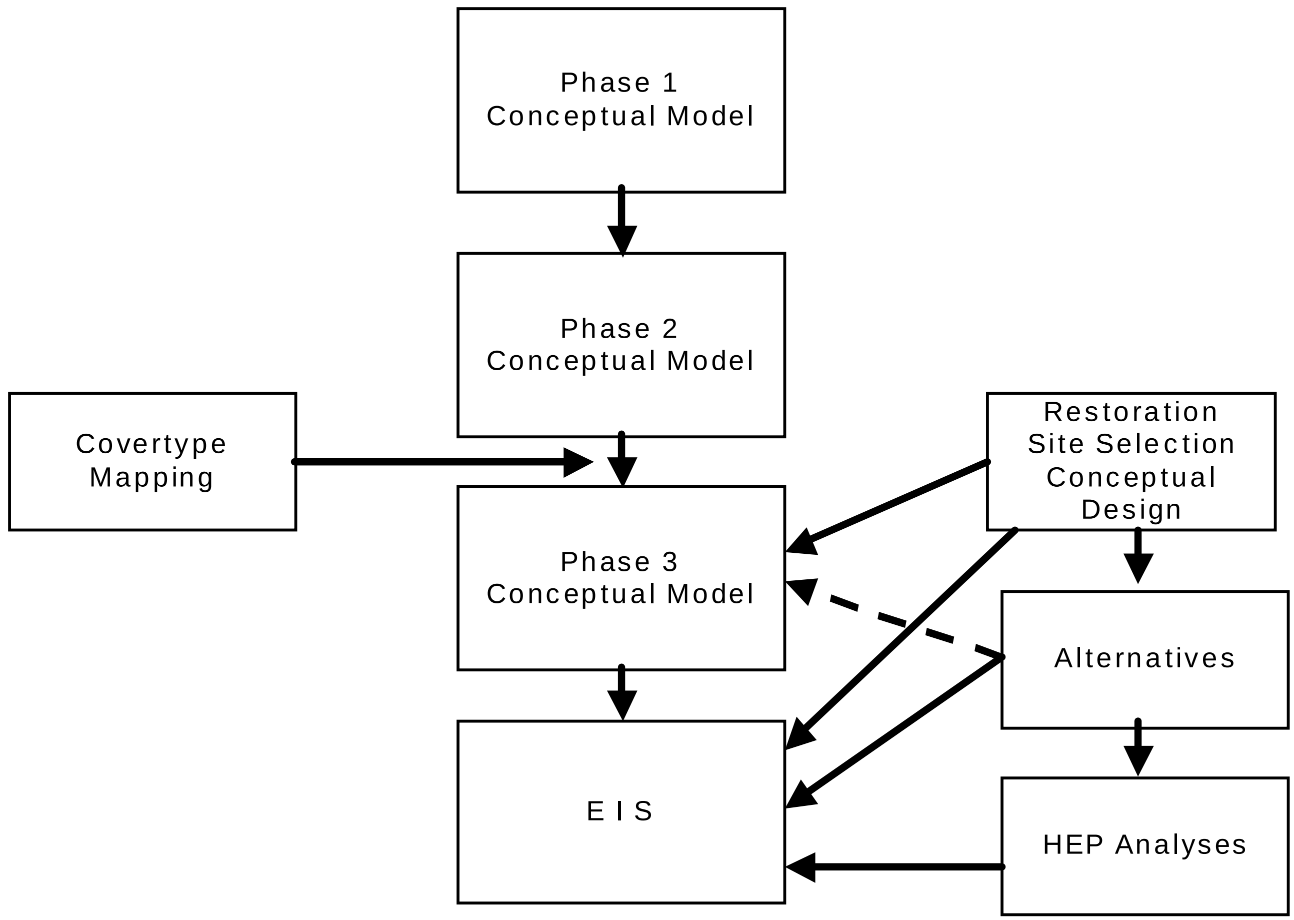


Figure 2 – Conceptual Model Development Process

Phase 3 Conceptual Model

FIMP Reformulation Study –

U.S. Army Corps of Engineers, NY District

The conceptual model is a pathway diagram that graphically depicts relationships between an initial source of stress (driver) and potential environmental components (endpoints) that may be affected. Examples of the pathway diagrams are provided throughout Section 5. The model is used as an assessment tool, to delineate complete linkages or pathways between important drivers, stressors and important endpoints that should be further investigated. A driver is a natural or human event that can lead to an environmental stress that may be experienced by an ecosystem or one of its components. An endpoint is a valued environmental attribute that has particular ecological importance and/or societal value. These concepts and definitions were described in detail in previous reports (USACE 2001 and 2004).

The conceptual model diagram includes all possible pathways or linkages that may be of interest in a defined 'system'. The 'system' can be as small as an individual site, or as large and complex as an ecosystem. In the context of the FIMP project, implementation of features (storm damage reduction features and restoration features) in specific reaches of the study area have the potential to result in impacts to the ecosystem as a whole, even in areas where the specific project application is not directly applied. The assessment of these impacts will be defined by the models for each feature and subsequently addressed in the EIS. The individual models for the proposed features define all potential pathways to insure that all potential impacts are identified and are addressed in project management decisions.

The conceptual models for the FIMP study area habitats have been developed in Phase 1 and Phase 2 described below. In Phase 3, Storm Damage Reduction and Restoration feature models are developed as input to the EIS for the project. The conceptual models will be used to guide the evaluation of potentially significant impacts in the EIS.

2.1 PHASE 1 MODELS

The development of the Phase 1 models is detailed in the report produced subsequent to the workshops held on Long Island and at the Waterways Experiment Station (USACE 2001). The Phase 1 effort comprehensively and systematically identified all ecosystems, habitats, drivers, stressors and endpoints that could have any relevance to the FIMP study area and storm damage reduction project. Beginning with the identification of six subregions, an idealized transect of habitats was formulated that defined all possible habitats from the open ocean, across the barrier island, through the backbay areas, and onto the upland (Figure 3). This comprehensive set of habitats formed the basis for identification of a comprehensive list of reasonable habitat units that were incorporated into the final Phase 1 models.

The Phase 1 effort also included a delineation of all possible drivers based on known natural or human activities that could lead to environmental stress in a system such as the FIMP study area. The initial list included five natural drivers and 21 anthropogenic drivers that were considered by the workshop participants to be comprehensive and somewhat redundant. The list was further scrutinized to eliminate redundancy, resulting in a final list of four natural and eight anthropogenic drivers that would be included in the Phase 1 models.

All potentially relevant stressors were defined as part of the Phase 1 effort. Workshop participants separated stressors into physical, chemical and biological changes to which the ecosystem responds or changes. The process resulted in the identification of 20 physical stressors, four chemical stressors, and three biological stressors. These stressors represented a focus for the development of the Phase 1 models. Once the Phase 1 driver and stressor lists were

Section 2: Approach to model development. This section provides a brief summary of the development of Phases 1 and 2 of the Model, and how those components laid the foundation for the Phase 3 Model. A brief overview of the objectives of the Phase 3 Conceptual Model is provided.

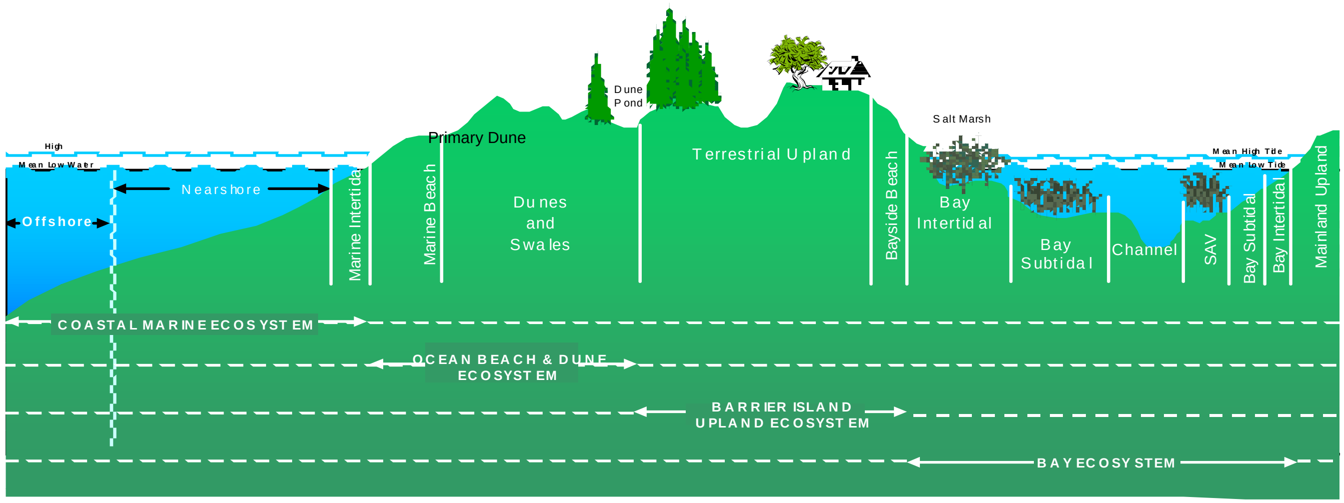
Section 3: Description and characterization of habitats along each of the 13 transects. Transects were identified by USACE to include the range of habitats present within the study area. This section includes the approach to transect identification, along with a description of each of the transects and how they typify segments of the study area. In the development of project-specific models, these idealized transects provide a list of the habitat types that might be encountered and incorporated in the model.

Section 4: FIMP Project. This section provides context for the selection of project features that are under consideration. Phase 3 models are habitat-based, but focused on these potential project features.

Section 5: Description of project and restoration feature models. This section describes in detail, the components of each of the 13 project/restoration feature models that form the basis of the Conceptual Model. For each model, the project feature is described along with relevant barrier island processes that may be affected. An assessment of potential biota that may be affected by the project feature is also included, along with a graphical representation of the model.

Section 6: Application of model to hypothetical projects. Two hypothetical projects are modeled to demonstrate how the models will be compiled and used in the EIS for the project.

Section 7: References. All citations used in the text are provided in this section.



Note:

1 - Nearshore habitat extends from mean low tide to 10 m depth

2 - Offshore habitat extends from 10 m depth to 30 m depth

3 – Bay Ecosystem also includes Sand Shoals and Mud Flats, and Tidal Marsh and Inlets habitats

Drawing not to Scale

Figure 3 –

Idealized Transect of Barrier Island Ecosystems

Phase 3 Conceptual Model

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finalized, workshop participants assigned qualitative weights (low, low/medium, medium, medium/high, high) to the individual driver/stressor associations. The strength of these associations helped identify the most likely impacted ecosystem components for each of the four ecosystems of concern (Coastal Marine, Barrier Island, Bay, and Upland) and their associated habitats. Habitat level stressor/effects matrices and conceptual models were then developed for each of the habitats identified.

2.2 PHASE 2 MODELS

The results of the Phase 1 effort formed the basis for the development of the Phase 2 conceptual models for the FIMP study area. The purpose of the Phase 2 effort was to refine and focus the Phase 1 work in a systematic review all ecosystems, habitats, drivers, stressors, and endpoints with the goal of developing models that could be more readily applied to the indigenous habitats and management options being considered for the reaches of the study area. Table 1 provides a summary of the final habitats identified in Phase 2. Table 2 is a comprehensive list of all endpoints associated with the 14 habitats.

As with Phase 1, a critical component of Phase 2 was consideration of input received from project stakeholders. The comprehensive Phase 1 habitat list was revisited to develop a representative list of habitats that occur within the study area. A four-person Scientific Advisory Panel was selected from a list of recognized experts and convened to provide peer review of the Phase 2 Conceptual Model. Based on comments received from that review, several revisions were made to the Phase 3 Conceptual Model.

Similarly, the comprehensive lists of drivers and stressors identified in Phase 1 were reviewed to identify and recommend modification to refine and focus the driver/stressor relationships to support the EIS process. The refinement resulted in the final incorporation of three Natural and six Anthropogenic Drivers into the Phase 2 Conceptual Model. Stressors were placed into the following categories that were incorporated into the model: Physical (two), Hydrological (five), Water Quality (seven), Biological (two), Human (one) and Other (three). The four ecosystems identified in Phase 1, Coastal Marine, Barrier Island, Bay, and Upland, were retained for inclusion in the Phase 2 Conceptual Model, but in some cases, the habitats within each of the respective ecosystems were redefined, resulting in a total of 18 habitat models.

The details of the Phase 2 approach and models were included in the Final Report (USACE 2004). A summary of the Phase 2 approach, along with the 18 Phase 2 models, is provided in Appendix A to this document.

2.3 DIGITAL MODEL

In an effort to develop a graphical presentation of the 18 Phase 2 models, and the 13 Phase 3 Models, a computer-based, digital power point presentation was developed (USACE 2005a). The Digital Model was organized according to the 18 models, and also included models for the project features. It is a useful communication tool describing the project components in the context of the study area habitats.

2.4 PHASE 3 MODELS

The Phase 3 Conceptual Model includes habitat-based models for each of the storm damage reduction and restoration features. The objectives of the Phase 3 or Final Conceptual Model are to:

- Identify and characterize idealized transects for the study area
- Consider development of additional habitat-specific models if needed
- Develop feature-specific, habitat-based models
- Identify relevant habitats and endpoints for each project feature or combination of features
- Delineate complete pathways or linkages for each project feature model that should be addressed in the EIS

Once the components of each project feature were defined, the FIMP study area cover map, provided in Appendix B, was consulted to delineate potentially involved habitats. Corresponding models for each habitat potentially affected by the project feature were assessed concurrently so that landscape level impacts were also incorporated into the model. Both storm damage reduction and restoration features were considered, along with the no-action alternative. Incorporation of drivers, stressors and endpoints of individual habitat models that may be involved in the implementation of a project feature provides for the assessment of the relationships among species and habitats over a wider area. This step also provides the opportunity to consider the significance of a stressor to a particular habitat and project feature. If endpoints utilize several habitats for different essential life stages, certain potential impacts may be realized both in the immediate habitat, and in other habitats utilized by the endpoint.

The analysis examined a range of species in the identification of endpoints and incorporated representative or indicator species for the habitat being modeled. Once the specific organismal grouping such as Vegetation, Invertebrate, or Finfish is indicated in a conceptual model for a specific habitat, the detailed list of endpoints provided in Table 2 was consulted for identification of specific endpoints that would be involved in the conceptual model under the specific project features being considered. In some cases, indicator species were chosen from data collected as part of the extensive FIMP studies performed to date based on similarity to its associated guild species in terms of habitat requirements and behavior. Indicator species may also include species of importance or relevance to a specific habitat zone.

The overall objective of the final model development was to identify relevant pathways or linkages that must be explored in the EIS for the project, including the rationale for inclusion or elimination of each potential pathway. In this way, the EIS will be a comprehensive, environmentally sound and technically defensible document that incorporates the interests of all stakeholders and addresses all potential positive and negative impacts of the FIMP project.

2.4.1 Revisions to Phase 2 Model

Several minor revisions were made to the Phase 2 Model based on comments from the Scientific Advisory Panel including:

- Sandy Intertidal habitat was renamed Marine Intertidal to account for Rocky Intertidal habitats in the eastern portion of the study area
- Sandy Beach habitat was renamed Marine Beach to distinguish the bayside and oceanside habitats
- Additional endpoints were included in the models for Marine Offshore, Marine Nearshore, Marine Intertidal, Bay Intertidal, Bay Subtidal, Sand Shoals and Mud Flats, and SAV
- Habitat Response

The Interagency Committee provided input on approaches to incorporate Habitat Response into the Conceptual Model at a meeting on May 7, 2004 that was convened for review of the Draft Phase 2 Model. Subsequent to the meeting additional individual input was requested from each agency. The following section addresses Habitat Response in the Phase 3 Model based on this input.

2.4.2 Habitat Response

One of the elements of the Phase 2 Model that was to be finalized in the Phase 3 Model was the definition of Habitat Response. The Scientific Advisory Panel, as well as other stakeholders and reviewers, were also solicited for input into the definition and importance ranking of features of Habitat Response.

Habitat Response is a critical component of the Conceptual Model because the nature and magnitude of the response of individual habitats will form part of the basis for site-specific impact assessment for each of the proposed projects. The Phase 2 Conceptual Model included a general description of Habitat Response that would allow the development of the model to continue without going into extensive detail for each pathway (Section 3.4, Phase 2 Development of the Conceptual Ecosystem Model for the Fire Island Inlet to Montauk Point Study Area; September 2004).

After careful consideration of all approaches discussed at the Interagency Meeting, a semi-quantitative weighting of endpoint features was developed that incorporates the opinions of the agencies. The objective was to characterize how important or 'significant' the Habitat Response would be for a given pathway that incorporates that endpoint. That is, to determine what makes specific pathways or linkages for certain habitats more important than others from an environmental impact standpoint.

The following list of endpoint features was considered in the weighting of potential pathways based on discussions from the Interagency Meeting, subsequent input from the agencies, and an understanding of the FIMP study area:

- <u>Endpoint presence in the habitat</u>: Represents the list of all endpoints summarized in Table 2.
- <u>Presence of Essential Fish Habitat</u>: Fish species include but are not limited to red and white hake, scup, bluefish, Atlantic butterfish, herring, winter and summer flounder; Invertebrate species include ocean quahog, surf clam and horseshoe crab.

- Presence of species of local interest or importance: The Diamondback Terrapin and the Northeast Tiger Beetle are no longer on the list of Endangered Species, but are given attention in the Conceptual Model for their local importance; the Northeast Tiger Beetle is extirpated (ie., no longer found in the state, but occurs elsewhere).
- Presence of threatened or endangered species or their habitat: Species include but are not limited to Kemps-Ridley, hawksbill, loggerhead, green and leatherback sea turtles, osprey, common, least and roseate terns, piping plover and short-eared owl.
- Commercial or Recreationally Important Species: Such as surf clams, scallops, ocean quahogs, lobster, squid, hake, scup, bluefish.
- Regulatory Basis for Protection (not addressed in other features):

    - NYSDEC Article 24, Freshwater Wetlands
    - New York State Tidal Wetlands Act, Article 25
    - Marine Mammal Protection Act
    - Migratory Bird Treaty Act
    - Commercial and recreational fishing laws
    - Federal Endangered Species Act
    - Fire Island National Seashore General Management Plan
    - 36 CFR Ch1 Part 28: Fire Island National Seashore: Zoning Standards

Based on these features the following semi-quantitative weighting was developed and applied to pathways between stressors and endpoints for habitats of interest:

- Rank of 1: Indicates presence alone, with no particular significance. Least important relative to other endpoints or pathways; any endpoint retained for the purpose of further assessment in the habitat-specific model will receive a Rank of 1
- Rank of 2: Endpoint has commercial or recreational importance and/or has a regulatory basis for protection
- Rank of 3: Most important; endpoint is State or Federally listed Endangered or Threatened

The overall importance of each endpoint feature in determining the severity of the potential impact was assigned one of these ranks to facilitate impact assessment and decision-making. Ranking values are used to express the relative importance of a given pathway ranging from highly important to unimportant. That is, the greater the importance, the more severe the potential impact is likely to be, and the more carefully the pathway should be considered in the EIS.

The approach to rank endpoints is intended to highlight or focus on potential linkages that may be worth assessing in the EIS. The mere rank of an endpoint does not represent the impact assessment, nor does it imply that the impact will definitely occur. Similarly, the rank of 1 versus 2 does not imply that potential impacts are twice as likely or twice as significant. Any habitat where impact ranking associated with the project feature is greater than 1 should be carefully considered for assessment in the EIS.

2.4.3 New Model Development

During Phase 1 and 2 of the development of the conceptual model, there were several cases where habitats were combined to facilitate model development. For example, freshwater wetlands that may occur in the Barrier Island Upland Ecosystem were lumped into the Upland Terrestrial habitat. It was specified in the Phase 2 Model, that once reach specific feature was defined and relevant habitats listed, a determination would be made as to whether any additional habitat specific models would be developed. Models that might be considered based on their frequency of occurrence, uniqueness and sensitivity included habitats such as freshwater wetlands, tidal creeks, and coastal ponds.

The idealized transects previously selected for the impact analysis incorporated the following habitat types that had not been modeled:

- Freshwater Wetlands
- Coastal Ponds

Coastal Freshwater Wetlands and Coastal Ponds are unique and valuable resources to be protected within the study area. Model development associated with these habitats is discussed in more detail in the following paragraphs:

Freshwater Wetlands. Freshwater Wetlands are a minor habitat within the study area in terms of aerial extent. However, they do occur in several of the transects considered representative and are regulated by NYSDEC Article 24, Freshwater Wetlands. While a separate habitat model was not developed for Freshwater Wetlands, collectively, the Bay Intertidal and Subtidal models include all drivers and stressors relevant to Freshwater Wetlands habitat. Endpoints are included in the list for the Barrier Island Upland Ecosystem (Table 2; Appendix A, Figure A18).

Coastal Ponds. As with Freshwater Wetlands, Coastal Ponds are a unique but minor habitat within the study area in terms of aerial extent. The Bay Intertidal (Appendix A, Figure A8) and Subtidal (Appendix A, Figure A11) models incorporate all relevant drivers and stressors for Coastal Ponds. Ecological endpoints of Coastal Ponds are included in the list for the Barrier Island Upland Ecosystem (Table 2).

While much information on the extent and location of various cover types along the South Shore of Long Island is readily available, a comprehensive map and/or Geographic Information System (GIS) that defines and identifies all the cover type was not available prior to mapping work performed by the USACE as part of the Reformulation Project (USACE 2005b). Cover type mapping was performed for the entire FIMP study area and includes all of the land area of Long Island The southern extent of the cover type map is the outer limit of the offshore zone.

3.1 MAP CREATION

The approach to the habitat mapping effort was a two-phase process detailed in the mapping report (USACE 2005b). Phase 1 included:

- Identification of existing digital geo-spatial data
- Acquisition and processing of data into a unified GIS database and reclassification into habitat types used in the Conceptual Model (USACE 2004)
- Creation of a digital map series
- Modification of attribute definitions for consistency with the Conceptual Model
- Updating of the GIS layer to incorporate habitat delineation edits

The goal of Phase 2 was to create a more useful tool for further analysis by updating and adding new information to the Phase I cover type map. Maps were updated and profile views of idealized transects were developed. The specific objectives of Phase 2 were to update the original cover type map created in Phase 1, using information gathered from ground-truthing, review of the 2001 Digital Ortho-photo Quads, and to revise attribute definitions. Data from the updated cover type map were then processed and used to create the profile view illustrations. Appendix B provides the transect location index and the transect cross sectional maps for the idealized transects.

Thirteen representative transects were developed for the area of Fire Island Inlet to Montauk Point. These transects were developed with the intent of capturing the range of habitats and development patterns that exist within the project area, levels of manipulation, and variability within the natural landscape. These transects will be used to characterize the complete project area. A description of each of the idealized transects is provided in the following section. Refer to Appendix B for the index and maps.

3.2 TRANSECT HABITAT CHARACTERIZATION

This section describes each of the 13 idealized transects identified for the study area. The transects are presented according to the bay area with which they are associated. Figure 1 provides the locations of the project reaches. Table 3 summarizes transect characteristics by project reach.

Table 3 describes the transect characteristics including the location of each transect, habitats and endpoints. The information included in this table is critical to the project-specific impact assessment model development and impact analysis (Section 6.0). Each transect lists the four ecosystems of the study area and those habitats within each ecosystem that actually occur in that transect. For each ecosystem a list of potentially affected endpoints is provided; endpoints are categorized as aquatic, transitional, and terrestrial. The status of each endpoint is used to distinguish between species that are merely present, commercially and recreationally important, or threatened and endangered. Vulnerability of species is determined based on status of the species and potential impacts within each habitat.

Project reaches were identified as those shoreline segments for which storm damage reduction improvements are somewhat independent of measures adopted elsewhere in the study area. The principle factor considered was the provision of storm damage reduction benefits associated with project implementation for a contiguous area. Hence, project reaches were established for the barrier island such that storm damages for all related leeward areas are reduced. The Reformulation Report will provide a more detailed description of proposed projects by reach.

The following is a description of the identified project reaches for the Reformulation Study:

Great South Bay Project Reach (GSB) – Smith Point to Fire Island Inlet. Storm damages in the project area within Reach GSB are primarily a consequence of inundation within Great South Bay. Residential development along the barrier shoreline is also subject to damages arising from storm erosion and inundation. This project reach includes the Federal Navigation Project at Fire Island Inlet and most of the Fire Island National Seashore and Wilderness Area.

Moriches Bay Project Reach (MB)– Quogue to Smith Point. Low-lying areas along the mainland shore of Moriches Bay are subject to inundation damages associated with storm occurrences and damages to the fronting barrier island shoreline. Furthermore, development along the barrier shoreline is subject to damages associated with storm erosion and inundation, and Moriches Inlet is subject to stability concerns in the event of barrier breaching. The recently constructed Westhampton Interim Project and the federal navigation project at Moriches Inlet are within the boundaries of Reach MB.

Shinnecock Bay Project Reach (SB) – Agawam Lake to Quogue. Extending from Agawam Lake to the Quantack Canal in Quogue at the easternmost groin in the Westhampton groin field, Reach SB represents the entire barrier shoreline fronting Shinnecock Bay. The principle storm damage mechanism therein is the result of barrier island damages and storm inundation along the low-lying areas along Shinnecock Bay. Along the barrier shoreline, the fishing cooperative and the integrity of Shinnecock Inlet are vulnerable to barrier island breaching. This project reach was separated since the provision of storm damage reduction for the entire Shinnecock basin is somewhat independent of other measures in the study area. Existing federal projects in the project reach include the navigation project at Shinnecock Inlet and the West of Shinnecock Inlet Interim Project.

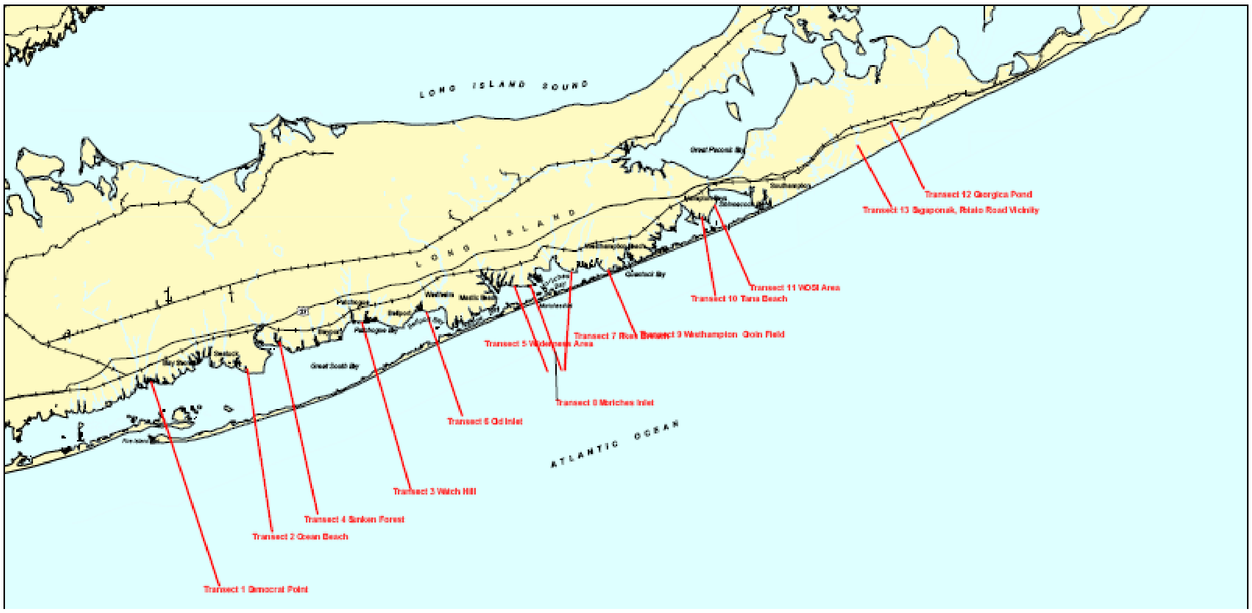
Ponds Project Reach (P)– Hook Pond to Agawam Lake. The mainland shore within this reach is characterized by segments of narrow beaches backed by dunes of varying elevation. Storm damage reduction feature design and evaluation are principally dependent on the interaction of the shoreline with erosion and flooding near Mecox Bay, Sagaponack Lake and Georgica Pond. Storm Damage Reduction Features at these locations are independent of other measures elsewhere in Ponds Reach, but the influence of these features on coastal conditions will be evaluated from the standpoint of the total project reach.

Montauk Project Reach (M)– Montauk Point to Hook Pond. Storm damage reduction provisions within Montauk Reach are based on localized existing storm vulnerability conditions. Specific storm damage problems encountered in the reach are summarized as follows:

- Bluff erosion along the ten miles segment at Montauk Point
- Inundation, erosion and wave attack vulnerability at the low-lying area at Ditch Plains
- Dune loss at Beach Hampton

No transects have been developed for this reach, but all habitats have been included in other models.

A summary of transect characteristics is provided in Table 3. A map of the transect locations is provided below showing the specific locations of the transects that are described in the following paragraphs. Additional maps of the individual transects are provided in Appendix B.



3.2.1 Great South Bay Project Reach Transects

Transect 1 - Democrat Point. Democrat Point is the most westerly transect of the FIMP study area (Appendix B, Map No. T1). The transect is approximately 8,600 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). This transect was selected as it represents the typical mosaic of habitats associated with a recreational park area, including paved parking areas and roads, and a level of dune and beach disturbances associated with a high recreational use.

Portions of the transect traverse the Atlantic Ocean and Great South Bay segments of the Coastal Marine and Bay Ecosystem models (Appendix B). In addition, it crosses four, publicly owned, land masses including Robert Moses State Park, Captree State Park, Oak Island and Grass Island, which are included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 1 – Democrat Point.

Transect 2 - Ocean Beach. Ocean Beach is in the western end of Great South Bay (Appendix B, Map No. T2). The transect is approximately 6,100 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). This transect is representative of a high density development, upland barrier island community. The vast majority of the upland portion of the barrier island contains extensive impervious cover that includes houses and related infrastructure. In some locations this development extends over and on to the Dune, Beach and Sandy (Ocean) Intertidal habitats (Appendix B). Extensive bulkheading has eliminated the transitional zone between the Bay and Upland Ecosystems however the bay habitat is quite healthy and supports an SAV bed.

As with Transect 1, portions of Transect 2 traverse the Atlantic Ocean and Great South Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 2 crosses one publicly owned, land mass, Fire Island National Seashore, which is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 2 – Ocean Beach.

Transect 3- Watch Hill. Watch Hill is a federally owned tract of land within the Fire Island National Seashore (Appendix B, Map No. T3). The transect is approximately 6,800 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). This transect was selected as representative of a low-density development, with little or no alteration of bayside shoreline habitats such as shoreline hardening and/or beach and dune manipulation. The area maintains its natural setting with the extensive SAV bed found in the subtidal bay.

Portions of the transect traverse the Atlantic Ocean and Great South Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 3 crosses one publicly owned, land mass, Fire Island National Seashore (Appendix B), which is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 3 – Watch Hill.

Transect 4 – Sunken Forest. The Sunken Forest is part of a federally owned transect of land within the Fire Island National Seashore (Appendix B, Map No. T4). The transect is approximately 8,800 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). It was selected based on its unique maritime forest community. Presently this area functions as a National Parks visitor center, offering educational and recreational opportunities. However, the existing marina has caused severe erosion to the bay shoreline which contributes to the loss of this unique national treasure. Bay shoreline erosion due to this and other causes is common throughout all of the bayside barrier island shoreline.

Portions of the transect traverse the Atlantic Ocean and Great South Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 4 crosses one publicly owned, land mass, Fire Island National Seashore (Appendix B), which is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. This Upland Ecosystem model includes the only Maritime Forest habitat. Table 3 includes a summary description of Transect 4 – Sunken Forest.

Transect 5 – A "Wilderness Area" (within Smiths Point County Park). A Wilderness Area is located within the Fire Island National Seashore boundaries and hence, is a federally protected tract of land (Appendix B, Map No. T5). Please note that this area should not be confused with the Federally designated "Otis Pike" wilderness area, also located within the FIMP project study area. The Wilderness area, under consideration for Transect 5, is a Brookhaven town park and includes the Great Gun marina. Since this area is used recreationally, it already exhibits some signs of degradation, but it is still considered a town "wilderness" area. The transect is approximately 4,300 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). It was selected based on its natural barrier island setting. The Tidal

Marsh is traversed by an unpaved access road, boardwalk and is void of tidal connection except under extreme tides and storms.

Portions of the transect traverse the Atlantic Ocean and Moriches Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 5 crosses one publicaly owned, land mass, Fire Island National Seashore (Appendix B), which is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 5 – Wilderness Area.

Transect 6 – Old Inlet. The Old Inlet transect is located within the Fire Island National Seashore, a federally protected tract of land (Appendix B, Map No. T6). The transect is approximately 3,800 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). This transect was selected because it represents an undeveloped portion of the barrier island which is likely to breach or overwash, and presently contains early successional habitat. It is a known likely breach / overwash location, is the site of an old inlet (now closed) and presently supports an early successional upland habitat. The dune at this location is extremely low and thus, still vulnerable to future overwash and breach events.

Portions of the transect traverse the Atlantic Ocean and Moriches Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 6 crosses one publicly owned, land mass, Fire Island National Seashore (Appendix B), which is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 6 – Old Inlet.

3.2.2 Moriches Bay Project Reach Transects

Transect 7 – Pikes Beach. Pikes Beach Transect is approximately 2,800 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island) (Appendix B, Map No. T7). This transect was selected because it represents a densely developed community, with an unstabilized bayshore line, which includes a large breach spit that formed as a result of the December1992 extratropical storm. The habitat that formed as a result of Little Pikes Breach, commonly referred to as a breach spit or overwash fan, presently contains an extensive mudflat and early successional upland habitat that provides forage for threatened and endangered shorebirds.

Portions of the transect traverse the Atlantic Ocean and Moriches Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 7 crosses one privately owned land mass, the Westhampton Dunes community (Appendix B). The area in which the Westhampton Dunes community is situated is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 7 – Pikes Breach.

Transect 8 – Moriches Inlet. The Moriches Inlet transect is approximately 2,800 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island) (Appendix B, Map No. T8). This transect was selected because it is a typical inlet which represents the other two inlets within the study area, Shinnecock Inlet and Fire Island Inlet. Additionally, the transect traverses a county park and an extensive intertidal sand shoal and mudflat in the bay.

Portions of the transect traverse the Atlantic Ocean, Moriches Bay and Moriches Inlet, segments of the Coastal Marine and Bay Ecosystem models. Transect 8 crosses one publicly owned land mass (Appendix B). A portion of the transect is situated in the Ocean Beach and Dune and

Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 8 – Moriches Inlet.

Transect 9 – Westhampton Groin Field. The Westhampton Groin Field is the westernmost transect of the FIMP study area (Appendix B, Map No. T9). The transect is approximately 1,200 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). It was selected because it represents a disturbed beach that has been stabilized by a groin field, structures utilized to trap sand and disrupt Longshore Sediment Transport to prevent beach loss. These groins were constructed to protect homes in the heavily developed residential community that occurs adjacent to the beach.

Portions of the transect traverse the Atlantic Ocean and Moriches Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 9 crosses one privately owned land mass, the Westhampton Beach community (Appendix B). The area in which the Westhampton Beach community is situated is included in the Ocean Beach and Dune and Barrier Island Upland Ecosystem models. Table 3 includes a summary description of Transect 9 – Westhampton Groin Field.

3.2.3 Shinnecock Bay Project Reach Transects

Transect 10 – Tiana Beach. The Tiana Beach transect is located west of Shinnecock Inlet (Appendix B, Map No. T10). The transect is approximately 3,000 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). The Tiana Beach transect represents a large, flat beach and associated high vegetated dune. There is no infrastructure within this transect except for one paved road which bisects this beach/dune and a bayside tidal marsh. Further offshore in the bay, a healthy SAV bed can be found supporting various finfish and invertebrate species.

Portions of the Tiana Beach transect traverse the Atlantic Ocean and Shinnecock Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 10, located in the town of Southampton, includes Ocean Beach and Dune and Barrier Island Upland Ecosystems. Table 3 includes a summary description of Transect 10 – Tiana Beach.

Transect 11 – WOSI. The 'West of Shinnecock Inlet" (WOSI) transect is located immediately west of the Shinnecock Inlet(Appendix B, Map No. T11). The transect is approximately 3,200 meters in length (from the nearshore zone of the Ocean to the mainland shoreline of Long Island). While Transect 11 is very similar to the Tiana Beach transect, it was included as an idealized transect because it represents an area that has been influenced by the adjacent inlet, and is also the location of a current Interim Project for beach replenishment. There is no infrastructure within this transect except for one paved road which bisects this beach/dune and a degraded, bayside Tidal Marsh. Further offshore in the bay, a healthy SAV bed can be found supporting various finfish and invertebrate species.

Portions of the WOSI transect traverse the Atlantic Ocean and Shinnecock Bay segments of the Coastal Marine and Bay Ecosystem models. Transect 11, located in the town of Southampton, includes Ocean Beach and Dune and Barrier Island Upland Ecosystems. Table 3 includes a summary description of Transect 11 – WOSI.

3.2.4 Pond Project Reach Transects

Transect 12 – Georgica Pond. The Georgica Pond transect of the FIMP study area (Appendix B, Map No. T12) is located in the town of Easthampton. The transect is approximately 3,800 meters in length (from the nearshore zone of the Ocean to the Rt. 27 project limit on mainland Long Island) and is one of two idealized transects located on the mainland of the study area. It represents an area which contains a beach and dune system, backed by a brackish pond, with an ephemeral opening to the ocean. It includes a large beach supported by two groins and a Coastal Pond. From time to time the hydrology of the pond is manipulated by trenching on the beach that permits draining of the pond. The pond naturally refills on extreme tides. There are also freshwater inputs from groundwater discharge and stormwater runoff. Hence, the pond supports both estuarine and freshwater fish and benthic species.

Portions of the Georgica Pond transect traverse the Atlantic Ocean, a segment of the Coastal Marine Ecosystem model. The transect also includes the Ocean Beach and Dune Ecosystem. This transect also includes unique habitats of Coastal Ponds and Upland Terrestrial habitats on the mainland. Table 3 includes a summary description of Transect 12 – Georgica Pond.

Transect 13 – Sagaponak. The Sagaponak transect is located within the Potato Road vicinity of the FIMP study area (Appendix B, Map No. T13), in the town of Easthampton. The transect is approximately 2,450 meters in length (from the nearshore zone of the Ocean to the Rt. 27 project limit on mainland Long Island) and is one of two idealized transects located on the mainland of the study area on the eastern end of Long Island. This idealized transect was selected because it represents a typical mainland beach and dune system, with a low-density residential community.

Portions of the Sagaponak transect traverse the Atlantic Ocean, a segment of the Coastal Marine Ecosystem model. The transect also includes the Ocean Beach and Dune Ecosystem. This is the only transect where a small, suburban, freshwater wetland habitat is included. Additionally, this transect also includes Upland Terrestrial habitats on the mainland. Table 3 includes a summary description of Transect 13 – Sagaponak.

As discussed in Section 1, the purpose of the FIMP study is to recommend a long-term plan for reducing storm-realted risk to lives and property, which balances the needs for storm damage reduction and ecosystem restoration. Sections 4 and 5 of this report first provide an overview of the basic assumptions underlying the reformulation effort (Section 4), and an overview of the types of measures being considered, and the means to evaluate them with the conceptual model (Section 5).

The planning approach for the FIMP study is driven by overriding USACE principles and guidelines for evaluating and identifying a recommended plan. The study approach has been further refined by the Vision Statement (USACE 2005) which incorporates the overriding principles of the involved agencies. The Vision Statement also identifies a process to be followed to accomplish the combined objectives of the cooperating agencies. Most notably, the Vision Statement recognizes that storm damage reduction needs must be balanced with the environment. Furthermore, the Vision identifies the intent to reduce storm damages through the least intrusive means possible. The evaluation of alternatives considers the following range of options within this framework:

1) No action, represented by the Future Without-Project Condition,
2) Changes in the management of the existing system to help restore related processes,
3) Nonstructural measures,
4) Soft structural measures (eg., beachfill), and
5) Hard structural measures in combination with beachfill.

In order to further define the framework for ecosystem restoration, a “Restoration Framework” has been developed, which is described further in Section 4.2. The Restoration Framework highlights that the intent of the FIMP study is not to restore a particular habitat for a specific purpose; the intent is to focus on the restoration of underlying processes which drive the system, to restore the island to a more naturally functioning condition, and contribute to storm damage reduction.

The overall planning process for the FIMP study is modeled after the following 6-step, iterative planning process developed by the USACE:

1 – Specify Problems and Opportunities

2 - Forecast Conditions Without Project

3 - Formulate Alternative Plans

4 - Evaluate Alternative Effects

5 - Compare Alternative Plans

6 – Select Recommended Plan

As part of this study, the USACE has undertaken extensive investigations to characterize the existing physical, social, natural and cultural environment. This effort has been utilized as the basis for identifying problems and opportunities by subareas along the shoreline. In general, the study area is represented by three major areas, which are unique in their physical setting:

1 – The ocean shorefront area from Southampton to Montauk

2 – The barrier island from Fire Island Inlet to Southampton

3 – The back bay areas along Great South, Moriches, and Shinnecock Bays

These areas have been further broken down into five geographic reaches, and a number of smaller design reaches, which serve as the basis for the problem identification, alternative development and evaluation of alternative plans.

The forecasting of the Future Without-Project Condition is described in Section 4.1. The forecast of the future conditions is a projection of what is likely to happen in the future in the absence of any project resulting from the Reformulation Study. As such, it projects a continuation of what has been experienced in the past, as an indicator of what is likely to continue into the future, and generally represents that past history of haphazard approach to shoreline management.

There are a number of project alternatives being developed to address the problems and opportunities. The different features or measures that would be combined to form the alternatives are described in Section 5, which details how these alternative features would be evaluated in the conceptual model.

The conceptual model will be used in conjunction with the HEP analysis to identify the environmental consequences of the alternatives under consideration, which will be integrated with the storm damage reduction benefits to identify a recommended plan.

The remainder of Section 4.0 provides a more detailed description of the future condition without the project, the key processes that comprise the restoration framework, and storm damage reduction.

4.1 NO ACTION ALTERNATIVE

The No Action Alternative assumes a continuation of a number of background events that are expected to occur independent of the project activities. These events combine to form the Future Without-Project Conditions, the baseline against which alternative costs, impacts and benefits are measured. The purpose of this No Action Alternative is to examine those changes throughout the remaining 50 years from construction of the project. Projections of with- and without-project conditions consider national and regional forecasts of socio-economic factors (e.g., income, employment, populations, etc) and other projections such as land use trends. Expected environmental conditions, especially trends in ecosystem change, are also to be considered in projecting with- and without-project conditions. The Future Without-Project is defined as the most likely future conditions in the absence of a proposed Federal project.

In defining the Future Without-Project, the following conditions are considered of particular importance:

- The maintenance of existing inlets (Fire Island, Moriches, and Shinnecock Inlets) and navigation channels. The existing inlets (Fire Island, Moriches, and Shinnecock Inlets) and their corresponding approach and backbay navigation channels will be maintained near the current widths and depths through the 50-year project life.
- Actions to maintain some threshold beach condition. Periodic beach fills (i.e., maintenance or periodic renourishment) will continue to maintain some threshold

beach condition. This condition is based on a review of historic activities including major Federal actions, such as Operation 5-High undertaken after the 1962 storm, and the extent of local and private activities.

- Status of the interim storm protection projects. No Federal interim storm protection projects will be considered in place under the future condition, except for the Westhampton Interim Project, which will be maintained until the end of the maintenance period (2027). It is anticipated that the interim project west of Shinnecock Inlet will be constructed, but that the 6-year renourishment period will have expired prior to construction of any projects recommended by the Reformulation Study.
- Closure of breaches in the barrier islands. Breaches in the barrier islands will be closed either through natural means or human intervention. Due to the need to obtain permits and funding approval, it is estimated that closure would occur within approximately 12 months. This condition is based on the historic pattern of repeated breach closures, including after the storms of 1938, 1954, 1962, 1980, and 1992.

The Interim Breach Contingency Plan (BCP) is not in place and will not be considered as part of the Future Without-Project Condition. The existing plan was approved as an interim action pending the outcome of the Reformulation Study to ensure that funding and permits are in place to allow immediate closure (within three months of occurrence). Impacts to future development or redevelopment within the storm damage hazard areas include:

- Coastal Processes. The Future Without-Project anticipates that the frequency and intensity of future storms will not change and that the wave climate will be similar to historic patterns. Sediment transport and rates of long-term erosion will also be similar to historic rates.
- Actions to Maintain a Threshold Condition. Unless specific plans or policies are identified that would alter future conditions, it is assumed that past actions are the most reliable indicator of the Future Without-{roject.
- Non-Federal Efforts. Non-Federal efforts would continue, including localized “soft” protection measures. The future condition anticipates that inlets and approach and back-bay navigation channels in the area will be maintained through periodic dredging and that these ongoing efforts will not measurably alter the existing hydrodynamics of the inlets and bays.

The environment of the FIMP study area is a complex, dynamic system influenced by both natural processes and human policies and programs. Study area habitats may change in the Future Without-Project in response to numerous factors, including ongoing natural succession, sea level rise, coastal erosion and related erosion control activities, periodic breaching and overwash, as well as, land and infrastructure development. These factors may impact some or all of the study area habitats. The future habitats and natural resources of the barrier islands will be influenced by:

- Continued sea level rise
- Breaching/overwash

- Related sediment transport
- Erosion control
- Post-storm restoration activities
- Development and redevelopment

In the Future Without-Project, it is expected that future environmental changes will occur within the estuaries and along the bay shores. It is expected that long-term impacts to the estuary will result from increases in sea level. Short-term impacts will result due to future barrier island breaches. The following changes would have short-term impacts on the future bay water quality, but may also have greater impacts to both geological and biological components of the environment:

- Altered tidal exchange
- Higher tides and increased flooding
- Potentially increased wave energy along the mainland
- Changed salinity distribution

The Future Without-Project habitats and natural resources of the barrier islands will be influenced by continued shoreline change, sea level rise, breaching/overwash and related sediment transport, erosion control and post storm restoration activities, and development and redevelopment. While the barrier may overwash or be breached during storm events, it is expected that such breaches will be closed through human intervention. It is expected that these areas would subsequently revegetate to a level consistent with the level that has been observed in the study area. Overwash will also result in short- and long-term changes to vegetation on the barrier island. In some areas, burial of wetlands or SAV may occur, while in other areas overwash will initiate the accumulation of sediment in depositional areas and the establishment of new habitats.

The greatest impact to upland areas in the Future Without-Project Condition is continued development associated with projected increased population. The need for additional housing and infrastructure is likely to result in a loss of open space and natural habitats within the study area, and impacts directly associated with these anthropogenic activities.

4.2 RESTORATION FRAMEWORK

The FIMP project is designed to reduce the risk and loss of human life and property as a result of storm damage. Storm damage reduction will be accomplished by restoring important structural, functional features and the integrity of Long Island's South Shore barrier islands, coastal ecosystem, and other natural protective features. In restoring coastal processes and natural protective features, such as barrier islands, nearshore areas, beaches, dunes and wetlands, the Long Island South Shore will strengthen protective capabilities, reducing risk to human lives and property.

The study area is subject to global scale processes. The ecosystems within the study area are adapted to change. The resilience and sustainability of the ecosystems depends upon the maintenance of important coastal processes. The FIMP study plans to restore physical coastal processes, particularly in the hydrological and geomorphologic systems. The study will focus on the following five physical processes to maintain or restore the protective features: Longshore Sediment Transport, Cross-Island Sediment Transport, Dune Development and Evolution, Bayside Shoreline Processes, and Estuarine Processes.

Table 4 describes each of the project features and the associated Barrier Island Processes. It provides a summary of the interrelationships between the proposed project features and which of the Barrier Island Processes may be affected. The following sections describe these processes.

4.2.1 Longshore Sediment Transport

Longshore Sediment Transport refers to the daily movement of sediment along the coast. While Longshore Sediment Transport affects the overall sediment budget of the barrier island system, it is particularly critical to reaches which include inlets, since the inlet can act as a sink for longshore sediments. Longshore Sediment Transport can intensify during storms and hurricanes by transporting greater quantities of sediment during the time of the storm. In the study area the Longshore Sediment Transport is generally from east to west. Longshore Transport contributes to the establishment and maintenance of protective features along the coast. Restoring Longshore Sediment Transport will benefit key species and habitats. Coastal Marine Offshore, Marine Nearshore and Marine Intertidal habitats rely on Longshore Sediment Transport for larval distribution. Barrier Island and Marine Beach habitats require Longshore Transport to sustain organisms that depend upon these habitats. Restoring Longshore Transport also allows for a more natural development of the shoreline and habitats for fishing, recreation, and aesthetic values. Additionally, Longshore Transport restoration helps reduce erosion rates resulting from artificial disruptions.

4.2.2 Cross-Island Sediment Transport

Cross-Island Sediment Transport refers to the movement of sand back and forth between the offshore bar, beach face, berm, dune, island core, bayshore, and bay across the barrier island. It is particularly important in areas of historic overwash such as Old Inlet or Smith Point County Park. Daily processes and seasonal conditions, such as storms, changes in sea level, and aeolian processes support Cross-Island Sediment Transport. Cross-Island Sediment Transport is critical in supporting the development of natural communities and biodiversity. Restoration of the Cross-Island Sediment Transport processes will allow for a more natural biodiversity of habitats with the variability of responses within the project area.

4.2.3 Dune Development and Evolution

Coastal dunes play an important role in the Marine Beach habitat. They serve an important ecological function by providing habitat in the transition zone between exposed beach and the sheltered landward portion of the barrier island.

In addition to their ecological roles, dunes provide a variety of services in terms of barrier island geomorphology. Dunes play an integral role in the sand sharing system. They accumulate sand at the upper margin of the beach. During a storm the sand may be removed by wave erosion, but over time new sand will accumulate. Dunes tend to recover more slowly than adjacent beaches.

Dunes also act as a storage area for sand, which helps to reduce the effects of erosion during serve storms and conditions that add significantly to sediment transport along the barrier island. In addition, dunes act as a barrier or wall to protect against storm surge and wave penetration.

Human activities have infringed upon the natural dune system by not allowing the natural transport of sand, which prevents the dune from assuming its role in the ecosystem and carrying out natural processes. Therefore, the process of Dune Development and Evolution is particularly important in areas of existing development where restoration of dunes would mitigate negative impacts of previous construction practices that limited the height and width of dunes, (such as those in the western communities of Fire Island). In these areas, restoring and maintaining the natural dune processes will allow for the dune to protect the interior landscape, acting as a buffer to the effects of storms, as well as facilitating development of various habitats.

4.2.4 Bayside Shoreline Processes

Bay shorelines are comprised of narrow Bayside Beaches, Mudflats, and Tidal Marshes. The Bayside Shoreline acts as a buffer to waves and raising sea level along the barrier island. Bayside Shoreline are shaped from waves, winds, and tidally-generated longshore currents. The higher energy is focused toward the beaches while Tidal Marshes and eelgrass beds occur in the more protected areas. Beaches are more susceptible to erosion and are impacted by changes in sea level. Tidal Marshes and Mud Flats experience different processes to help maintain their integrity. These areas are shaped by slow currents to allow for deposition of fine grained sediment. During storm events Tidal Marshes are highly vulnerable to flooding. Natural bayside features reduce the risk of breaching and flooding along the barrier island. The functionality of the overall system relies on these Bayside Shoreline Processes that establish essential habitats. These habitats support the feeding, spawning, and growth of fish, crustaceans, shorebirds, and other invertebrates. Bayside Shoreline habitats also act as a natural filtration system by trapping pollutants transported from uplands.

Human activities have impacted the Bayside Shoreline Processes and habitats. A most visible example is near Fire Island Pines, where bulkheads have created significant shoreline erosion. Similarly, bayside structures such as marinas can obstruct bayside sediment transport. Another example is where dredging can cause removal or burial of wetlands. Dredging also removes material from the system, therefore upsetting the Bayside Shoreline Processes. Restoring Bayside Shoreline Processes will help maintain bayside habitats and their natural protective features.

4.2.5 Estuarine Processes

Estuaries are areas of transition from which fresh water meets with salt water. Estuaries allow an exchange of water from land to the ocean, distribute sediments, and circulate water to support estuarine habitats. Estuaries are driven by the amount of freshwater input, bathymetry, water exchange through inlets, and wind. The exchange of water within the estuaries helps to maintain water quality by clearing the system of pollutants and discharge of materials or nutrients into the system. Circulation patterns and sediment movement support the essential estuarine habitats and species, and associated shoreline habitats. These habitats include, Subtidal Bay, Shoals and Flats, and SAV beds. These habitats are vital to support the complex ecosystem with the estuary. Open Subtidal Bay habitats allow for circulation and mixing to occur, which aids in the distribution of plankton and larvae. Bay bottom provides habitat for shellfish and finfish. Sand Shoals and SAV (e.g., eelgrass beds) are important breeding, spawning, and feeding areas for crustaceans, shellfish, finfish, shorebirds and other species.

Storms provide natural disruption to circulation patterns within the estuarine system by causing surges into the bay and breaching the barrier island. Human activities further contribute to the disruption of Estuarine Processes. Human activities have increased the discharge of pollutants and nutrients into the water systems, which eventually flow through estuaries and adsorb to sediment. In addition, clearing of land for structural development can alter the bathymetry of the estuary and result in further disruption of circulation and water exchange. Restoring Estuarine Processes will improve the quality of the ecosystem and habitats. The complexity of estuarine circulation makes it difficult to restore Estuarine Processes, however restoring the bathymetry and topography within the estuaries provides opportunities for habitat restoration. Any restoration of inlet function will serve to enhance circulation and hence restore Estuarine Processes.

4.3 STORM DAMAGE REDUCTION

Relevant coastal processes within the project have been thoroughly identified in the study process and during various Coastal Technical Management Group Meetings (CTMG). These issues include sediment transport and shoreline erosion, overwash and breaching, barrier island migration, storm surge and flooding, and inlet stability and navigability.

The project is intended to provide protection from damages to existing commercial, residential, public and other infrastructure in the study area during severe storms. These damages are associated with extreme tides and waves that can cause extensive flooding and erosion within both barrier island and mainland communities. Breaching and/or inundation of the barrier island may also lead to increased flood damages, especially along the mainland communities bordering Shinnecock, Moriches and Great South Bays. However, it is important that decisions made should be based on a clear understanding of natural barrier island behavior, as well as an acknowledgement of pre-existing anthropogenic perturbations. Proposed improvement plans should be formulated to interfere as little as possible with natural barrier island processes.

Potential structural solutions for the reduction of these damages identified to date include beach restoration alone and in combination with structures such as groins or buried rock revetments. These features will affect all of the coastal processes listed above. Moreover, changes might also affect other environmental conditions, particularly natural and economic resources. Specific issues that will be addressed in the study include:

- Changes to the existing sediment budget
- Changes to existing shoreline erosion/accretion patterns
- Changes to the littoral drift at the structured inlets
- Impacts to nearshore bar formations
- Changes in the level of protection against storm damage along the ocean shoreline
- Changes in storm water levels and related damages
- Reduction of breaching and overwash

- Reduction in sediment inputs to the bay
- Impacts to barrier island migration

The discussion of the issues will also include the potential consequences related to these coastal processes on the biological resources and habitats.

As summarized in Section 2, the Phase 2 Conceptual Model incorporated a total of 14 habitat-specific models representing the four ecosystems of the FIMP study area for a total of 18 models. Since the Conceptual Model development is an iterative process, each of these models is provided in Appendix A of this report for reference. Each model includes all possible combinations of drivers, stressors and endpoints relevant to the specific habitat. These driver-stressor combinations, generated from potential natural and anthropogenic impacts, were then applied to habitat types (Table 1). Once the specific habitat types are identified, endpoints relevant to the habitat are defined (Table 2). By including habitat-specific endpoints, actual biota that may be affected by a project are addressed. Endpoints are also characterized in terms of whether they are Aquatic, Transitional or Terrestrial. In addition, it is noted as to whether they have commercial or recreational significance or whether they are afforded regulatory protection. All of this information assists in the final understanding of the magnitude of potential impacts.

In Phase 3 of the Conceptual Model, the Phase 1 and 2 models were further built upon to build a framework upon which the assessment process can be guided. In all phases of the model, project and restoration features (sometimes referred to as project measures in other FIMP documents) can result in impacts to the habitats of the FIMP study area. In Phase 3, each of the potential project and restoration features are reviewed to determine which habitats might be relevant, and consequently, which endpoints could potentially be affected by project implementation. The flexibility in the model permits the compilation of several features that may comprise a specific project (An example of this is provided in the description of a hypothetical model in Section 6.2).

Phase 3 Models were developed for the following features:

- Groin Alteration and Construction
- Beach Nourishment/Renourishment
- Dune Modification
- Dredging
- Bulkhead/Seawall
- Inlet Sand Bypassing
- Nonstructural Features
- Upland Restoration
- Island Restoration
- Plantings and Invasive Species Control
- Bayside Shoreline Processes
- Tidal Marsh Restoration
- SAV Restoration
- Breach Contingency Plan

Phase 3 conceptual models are addressed in Section 5.1 below, along with a discussion of drivers, stressors and endpoints associated with each model.

Each of the project and restoration features has the potential to affect naturally occurring barrier island processes (Section 4.2). For each feature, potentially influenced processes are identified in Table 4. The potential effects on each process are discussed below along with the specific model.

Note that not all of these "alternatives" are under consideration for the final FIMP Reformulation Project. However, all possible alternatives (even those no longer incorporated into the current project design) must be completed for a comprehensive impact analysis.

5.1 PHASE 3 CONCEPTUAL MODELS

5.1.1 Groin Alteration and Construction

Description. A groin is an engineered, shore protection structure used to trap littoral drift or slow the process of erosion of the shore. Since groins affect naturally dynamic sediment budgets, the effects of groins are also dynamic and constantly changing. Groin alteration, as defined here, involves modifying a groin structure such as groin removal, notching, or shortening. Groin alterations will affect the way a groin retains sand. Groin Construction involves the building of groin structures along the shoreline. Groins are classified as beach stabilization structures designed to impound sand. They are constructed perpendicular to the shoreline, extending from the dune/beach interface to MSL water depths on the order of 10-12 ft. They can increase the longevity of beachfill by reducing losses due to long-term erosion. Groins interrupt longshore sediment transport and promote sediment deposition; they are often constructed in series to provide protection to a continuous shoreline segment.

Existing groins are located in the Town of Easthampton, east of Georgica Pond, at Westhampton Beach and at Ocean Beach on Fire Island. Removal or modification (e.g., notching or shortening) of existing groins can augment the performance of other shore protection features such as beachfill. Modification can rectify adverse impacts to the beach and adjacent areas associated with the groin by restoring sediment transport.

Groin Alteration includes groin removal, notching, shortening and construction that are all dealt with in this section since all activities affect the same habitats and endpoints. While all three features potentially affect the same four habitats of Marine Nearshore, Marine Intertidal, Marine Beach and Dunes and Swales, the nature (ie., positive or negative) and magnitude of the potential impacts among these three groin features varies substantially.

Barrier Island Processes. Groin Alteration and Construction have the potential to affect the barrier island processes of Longshore Transport, Cross Island Transport and Dune Development and Evolution, all of which are interrelated (Table 4). Since groins are intended to modify sediment transport, all natural barrier island sediment transport processes will be modified to some degree by these features. As discussed above, groins affect Longshore Sediment Transport, and hence the development of sediment dwelling communities (ie., benthos) and the higher order consumers that rely on this food source. Similarly, Cross Island Transport is strongly influenced by Longshore Transport, and affects the distribution of beaches and the height, width and volume of barrier islands, associated dunes, and biota that inhabit them.

Phase 3 Model-Groin Alteration. Groin removal restores the component of the sediment budget involving longshore transport of sediment that was interrupted by placement of the groin.

In so doing it allows for natural restoration of downdrift habitats, but this restoration is variable and accomplished at the expense of updrift habitats providing the source of sediment. The effects of groin notching or shortening are similar to removal in that these activities restore some of the longshore sediment transport. Longshore sediment transport is required for natural development of the barrier island profile including offshore bars, beach slopes, berms, and dune systems. Downdrift intertidal habitats that are sediment-starved when groins are in place, are restored providing habitat for invertebrates that colonize the habitat. This restoration occurs by sediment transport from updrift habitats. Groin notching, shortening or removal can also positively impact higher order consumers that depend upon the invertebrates as a food source.

The construction phase of the removal would result in short term, localized negative impacts to endpoints in the immediate vicinity of the structure. In the long term, sediment transport afforded by the removal would be realized at downdrift locations where sediments would accumulate and create habitat. While potential effects of Groin Alteration have been simplified for the purposes of discussion, owing to the dynamic nature of the barrier island sediment budget, cumulative impacts would be realized over multiple habitats. The pattern of down drift sediment transport and deposition, with the formation of new habitats would be uncertain and ever changing. Figure 4 is the Phase 3 Model for Groin Alteration. Construction-Soft is the driver associated with these Groin Alteration activities since they involve removing a 'hard' or engineered structure.

The following four habitats could potentially be affected in the removal or alteration of groins since groins extend from the dune/beach interface to MSL: Marine Nearshore, Marine Intertidal, Marine Beach and Dunes and Swales. Note that potential drivers, stressors, endpoints and potential effects associated with groin removal also apply to groin notching and shortening. Potential impacts associated with groin notching and shortening would be much reduced relative to groin removal. In all cases, impacts are both positive and negative, since the habitat representing the source of sediment is typically removed as a result of natural transport to downdrift areas where new habitats are formed. In either event, the myriad of generally random elements (eg., hydrology, storm events, etc.) that influence sediment transport result in a constantly changing shoreline habitat profile, where habitats are alternately being formed and destroyed from natural events.

Aquatic endpoints that use the Nearshore and Intertidal habitats that could be affected by the restoration of longshore sediment transport associated with groin notching, shortening or removal include Vegetation, Invertebrates, Finfish, Birds and Marine Mammals. It is not surprising that all endpoints of the Intertidal Habitat could be affected due to changes in sediment transport and deposition. Increase in the extent of Nearshore and Intertidal habitats would increase the amount of habitat available for colonization by benthic invertebrates and fish and use by higher trophic level biota. Aquatic Vegetation and Marine Mammal endpoints might only be relevant in the Rocky Intertidal habitat at the eastern end of the study area where large rocks in the intertidal zone provide an attachment surface for algae and a haul out area for Marine Mammals. The Marine Mammal endpoint in the Phase 3 Model is ranked of moderate importance due to the existence of the Marine Mammal Protection Act. Aquatic Invertebrates, Finfish and Birds were most highly ranked due to the potential presence of Essential Fish Habitat, and the presence of Endangered and Threatened bird species. The Migratory Bird Treaty Act also affords protection to this endpoint. Birds could be especially vulnerable since

Figure 4
Phase 3 Conceptual Model - Groin Alteration
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - GROIN ALTERATION

HABITATS	STRESSORS
MARINE NEARSHORE (5)	Habitat Alteration Hydrological Alteration Changes in Wave Dynamics **Human Stressors** Species Displacement
MARINE INTERTIDAL (7)	Habitat Alteration Changes in Wave Dynamics Hydrological Alteration Circulation Changes Changes in Sedimentation Species Displacement **Human Stressors**
MARINE BEACH (4)	Habitat Alteration Changes in Sedimentation Species Displacement **Human Stressors**
DUNES & SWALES (5)	Habitat Alteration Hydrological Alteration Changes in Wave Dynamics Changes in Sedimentation Species Displacement

HABITAT RESPONSE

HABITATS	ENDPOINTS: Aquatic					Transitional			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds
Marine Nearshore	1	3	3	3	--	--	--	--	--
Marine Intertidal	1 [(1)]	1	3	3	2	--	--	2 [(1)]	3
Marine Beach	--	--	--	--	--	3 [(2)]	--	--	3 [(2)]
Dunes & Swales	--	--	--	--	--	3 [(2)]	--	--	3 [(2)]

Note: The driver for Groin Alteration is Construction - Soft.
Numbers in parentheses indicate the number of stressors associated with that driver.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver. Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
[(1)]Vegetation and Marine Mammals endpoints for the Intertidal Habitat refer to Rocky Intertidal Habitat only.
[(2)]Note that this model applies to Groin Shortening,Notching and Removal; while all endpoints are the same, potential impacts to Transitional endpoints due to complete Groin Removal are greatest.

they use Nearshore and Intertidal habitats for foraging. Anything that affects prey availability (eg., invertebrates and fish) would also affect Birds.

There are no relevant Transitional endpoints in the Nearshore habitat. While Transitional Amphibians and Reptiles, Marine Mammals and Birds were considered in the development of the Phase 3 Model for Groin Alteration, the likelihood of effects to these endpoints was considered negligible, so they were not included in the Nearshore model. Transitional endpoints of the Marine Intertidal, Marine Beach and Dunes and Swales habitats include Vegetation, Marine Mammals and Birds. Of these endpoints, Transitional Birds and Vegetation are likely affected the most since they include bird and vegetation species such as the Piping Plover and Sea Beach Amaranth, respectively, that are protected under the Endangered and Threatened Species Act. Marine Mammals are ranked moderately owing to protection afforded by the Marine Mammal Protection Act. Additional sedimentation in the Intertidal habitat that would occur as a result of groin removal, notching or shortening can indirectly lead to an increase in the extent of the Marine Beach and Dune and Swale habitats for potential colonization by the Sea Beach Amaranth or protected bird species such as the Piping Plover.

Terrestrial endpoints of Mammals and Insects were also considered in the development of the Phase 3 Model for Groin Alteration since they may be relevant to both the Marine Beach and Dunes and Swales habitats in updrift areas where narrowing of the beach will result in greater exposure to storm surges. However, the likelihood of affects to these endpoints was considered negligible, so they were not included in the final model. Terrestrial Birds and Amphibians and Reptiles of the Dune and Swales habitat were eliminated from the final model using the same rationale.

Phase 3 Model- Groin Construction. Groin Construction protects beaches from erosion by interrupting longshore transport of sediment. While the beach on the updrift side of the groin is stabilized, in some cases the downdrift side can be starved for sediment and may erode over time. By interrupting longshore sediment transport, Groin Construction will affect natural development of the barrier island profile.

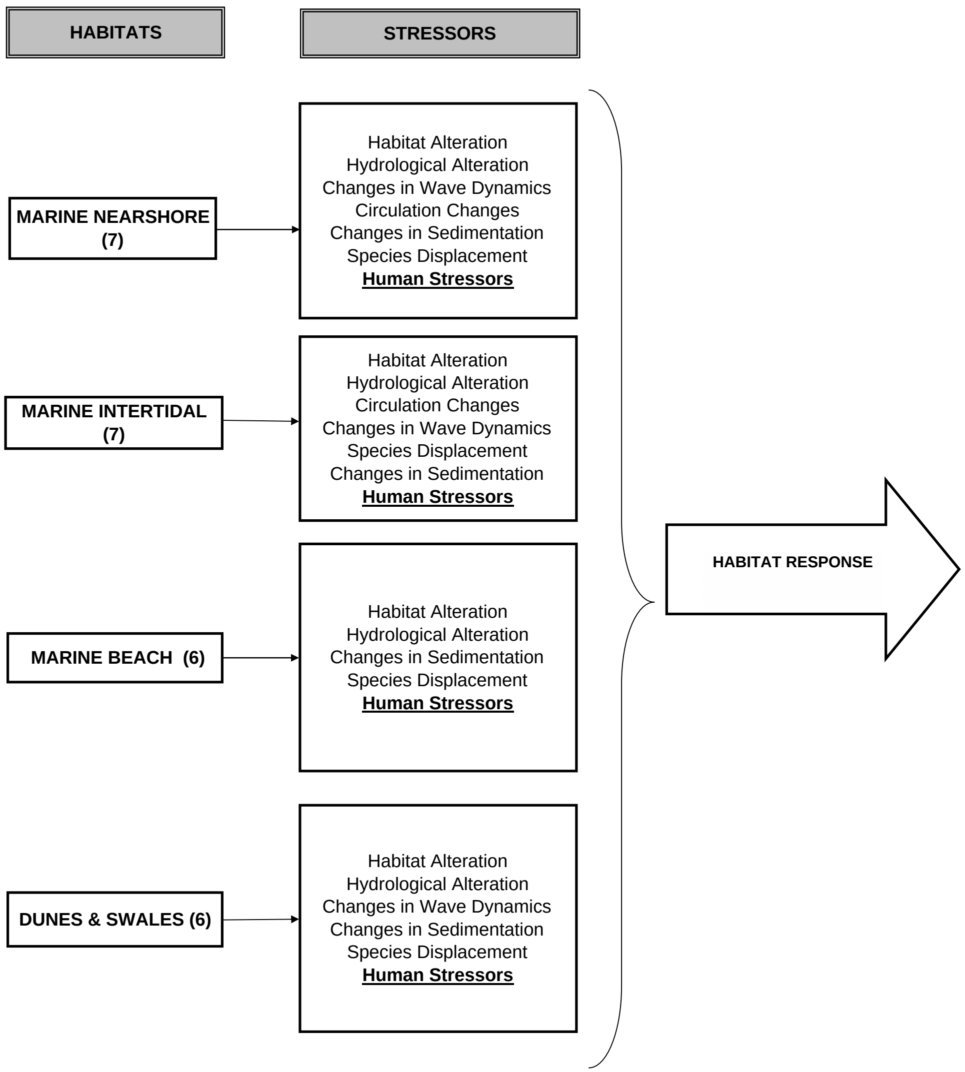
The construction of any structure would result in short term impacts to biota using the habitats associated with the construction activity. Every attempt would be made to limit the construction area and if possible, to schedule the activity during seasons that would be the least disruptive to natural biota. In addition, construction of groin features is usually accompanied by sand placement on the updrift side of the groin, providing an additional sand source, so that interruption of long shore sediment transport is not as severe.

Figure 5 is the Phase 3 Model for Groin Construction. It addresses both simple groins, and T-groins such as the one potentially associated with a bypassing alternative at WOSI (West of Shinnecock Inlet). Construction-Hard is the driver associated with Groin Construction since it involves placement of ‘hard’ or engineered structures. The Phase 3 Model for Groin Construction involves different driver/stressor relationships compared to Groin Removal, but the same habitats are involved. The following four habitats could potentially be affected in the construction of groins since groins extend from near the dune/beach interface to some depth below MSL: Nearshore, Intertidal, Marine Beach and Dunes and Swales.

Construction of groins in the intertidal areas creates surfaces for attachment and so creates habitat and increases habitat complexity; it also creates stability for infaunal forms. By

Figure 5
Phase 3 Conceptual Model - Groin Construction
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - GROIN CONSTRUCTION



HABITATS	ENDPOINTS: Aquatic					Transitional			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds
Marine Nearshore	**1**	**3**	**3**	**3**	**--**	**--**	**--**	**--**	**--**
Marine Intertidal	**1(1)**	**1**	**3**	**3**	**2(1)**	**--**	**--**	**2(1)**	**3**
Marine Beach	**--**	**--**	**--**	**--**	**--**	**3**	**--**	**--**	**3**
Dunes & Swales	**--**	**--**	**--**	**--**	**--**	**3**	**--**	**--**	**3**

Note: The driver for Groin Construction is Construction - Hard.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver. Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
(1)Vegetation and Marine Mammals endpoints for the Intertidal habitat refer to Rocky Intertidal habitat only.

stabilizing updrift areas it increases surface area of the habitats. However, downdrift areas become sediment starved and are subject to greater erosion.

Aquatic endpoints that use Marine Nearshore and Marine Intertidal habitats that could be affected include Vegetation, Invertebrates, Finfish, Birds and Marine Mammals of the Nearshore and Intertidal habitats. As discussed above, introduction of a hard surface would permit greater diversification of the otherwise, sand-dwelling, infaunal benthic community. Similarly, the rocks would provide hiding and feeding areas for fish that use these habitats. An increase in the benthos and prey fish in the groin areas would result in a greater food source for birds. Potential impacts to Aquatic Vegetation and Marine Mammal endpoints would be minor and limited to the eastern portion of the study area where rocky intertidal zones occur. Transitional Marine Mammals are ranked moderately owing to the existence of the Marine Mammal Protection Act.

Transitional endpoints are associated with the Intertidal, Marine Beach and Dunes and Swales habitats, and include Vegetation, Marine Mammals and Birds. All endpoints could be positively and negatively impacted. Transitional Vegetation of the Marine Beach and Dunes and Swales could be disturbed during construction, but could subsequently be restored. Transitional Birds are potentially affected the most since they use three of the four habitats, and include protected species; some forms are also protected by the Migratory Bird Treaty Act. Increase in food items could benefit local avifauna, while disturbance to nesting areas could negatively impact them.

No Terrestrial endpoints were included in the final model, however it should be noted that terrestrial habitats downdrift of a new groin may be at higher risk of storm damage. Vegetation, Birds, Mammals and Insects and Amphibians and Reptiles were also considered in the development of the Phase 3 Model for Groin Construction since they may be relevant to the Dunes and Swales habitat. However, the likelihood of affects to these endpoints was considered negligible, so they were not included in the final model. Terrestrial Mammals and Insects of the Marine Beach habitat were eliminated from the final model using the same rationale.

5.1.2 Beach Nourishment/Renourishment

Description. Beach nourishment generally involves the initial placement of sand removed from borrow areas to an eroding beach; renourishment is the ongoing placement of sand removed from offshore borrow areas to maintain beach design geometry. Beach Nourishment/Renourishment is applicable to oceanfront shorelines in areas that are subject to minor to moderate erosion, inundation and wave attack. Beach Nourishment/Renourishment by definition is not intended for any bayside areas in the FIMP study area. However, bayside shoreline restoration is addressed in Section 5.1.11 of this report.

The purpose of Beach Nourishment/Renourishment is to offset long-term erosion and to provide protection against storm-induced erosion and flooding. For the purposes of this model and hence for impact assessment, Beach Nourishment/Renourishment and sand placement are used synonymously; both terms refer to placement of material on a beach. From a design perspective the concepts differ, in that Beach Nourishment/Renourishment refers to an engineered design, and sand placement refers solely to material placement.

Beachfill normally consists of a design berm that protects the dune from erosion, and may include a dune that provides a barrier to storm tides and waves. Beachfill temporarily shifts erosion away from the natural beach and dune to the newly placed sand. If beachfill is repeatedly placed the net effect is to slow the impact of erosion over the long term. Modification of the dune, while a component of Beach Nourishment/Renourishment, is dealt with under a separate model in Section 5.1.3, below. Raising dune height will afford additional protection to overtopping or wave impacts during storms.

The primary impact of Beach Nourishment/Renourishment is the creation of a larger beach and dune cross-section on the ocean side of the islands. Beach Renourishment is not intended for any bayside areas. Environmental impacts associated with beach restoration range from short- to long-term alterations that include both positive and negative consequences. Intertidal impacts may include the disturbance of biota habitats affecting species feeding, nesting, nursing and breeding. Impacts in subtidal zones may include the burial of surf zone habitats, increased sediment concentrations and sedimentation during and following construction and nearshore bathymetric changes. Borrow area dredging increases turbidity, modifies bathymetry and removes benthic communities inhabiting surficial sediments, which may impact species feeding patterns.

Beach scraping is similar to Renourishment in that it involves the mechanical removal and/or recontouring of the beach profile. The lower beach typically provides a source of sand that is moved to the upper beach and/or dune. Once the beach elevation reaches a certain height, the remainder of the sand may be placed on the dune where it affords additional protection. Under current permits sand is removed from above elevation 7 feet. In the winter, sand is placed along the dune line, in the summer the piles are smoothed to level the beach for recreational use. This approach can be ecologically destructive since endpoints of the Marine Beach and Dunes and Swales are in a constant state of artificial manipulation. Since drivers, stressors and endpoints are the same as those for Beach Nourishment/Renourishment, beach scraping is also addressed by this model.

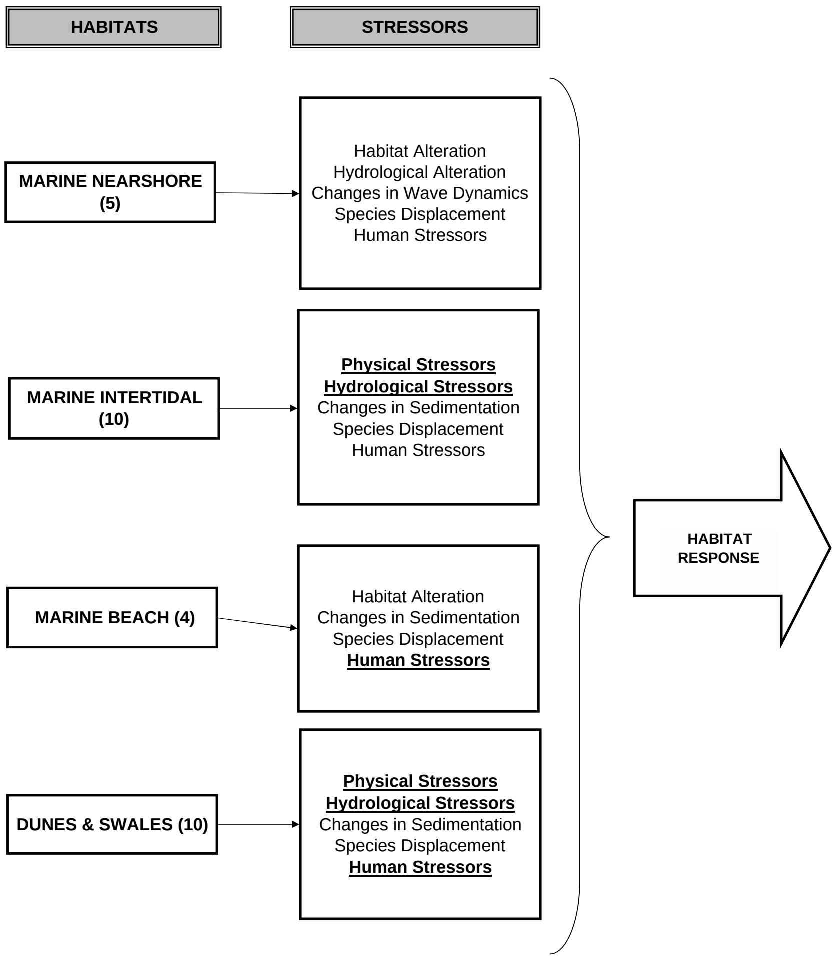
Barrier Island Processes. Beach Renourishment, and activities such as sand placement have the potential to affect the barrier island processes of Longshore Transport, Cross Island Transport and Dune Development and Evolution (Table 4). The greatest potential affects will be on the beach and dune areas, but adjacent intertidal and subtidal zones can also be impacted. Renourishment, or placement of sand on beaches provides an additional source for Longshore Transport and the ultimate placement in down drift habitat areas. A more direct affect is the expansion of beach and dune habitat areas.

Phase 3 Model-Beach Nourishment/Renourishment. Figure 6 is the Phase 3 Model for Beach Nourishment/Renourishment. Construction-Soft is the driver associated with Beach Nourishment/Renourishment since it requires only sand placement and no engineered structures. Note that Construction-Soft is also the driver for beach scraping. Potential impacts associated with Beach Nourishment/Renourishment may occur due to the placement of sand and may be felt in subtidal areas on the ocean side only; the project will not include renourishment on the bayside. The following four habitats could potentially be affected by Beach Nourishment/Renourishment: Marine Nearshore, Marine Intertidal, Marine Beach and Dunes and Swales. These same habitats could be affected by beach scraping.

All three categories of endpoints could be impacted by both Beach Renourishment and Scraping. Endpoints given the highest importance were based on the potential presence of Essential Fish Habitat and Endangered and Threatened species. Both of these features afford regulatory protection to these endpoints.

Figure 6
Phase 3 Conceptual Model - Beach Nourishment/Renourishment
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - BEACH NOURISHMENT/RENOURISHMENT



HABITATS	ENDPOINTS												
	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
Marine Nearshore	1	3	3	3	--	--	--	--	3	--	--	--	--
Marine Intertidal	1(1)	1	3	3	2(1)	--	--	2(1)	3	--	--	--	--
Marine Beach	--	--	--	--	--	3	--	--	3	--	--	--	--
Dunes & Swales	--	--	--	--	--	3	2	--	3	1	--	--	--

Note: The driver for Beach Nourishment/Renourishment is Construction - Soft.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
(1)Vegetation and Marine Mammals endpoints for the Intertidal Habitat refer to Rocky Intertidal only.
Impacts for Beach Scraping would be the same as those for Beach Nourishment/Renourishment.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
"Sand Placement" is a form of Beach Renourishment that involves little design or engineering but results in the same potential impacts; for the purposes of this model, it does not include sand placement associated with inlet bypassing.

Aquatic endpoints that use the Nearshore habitat that could be affected include Vegetation, Invertebrates, Finfish, and Birds. Placement of additional material on the Beach and in the Intertidal zone creates a net expansion and offshore progression of the Nearshore habitat. This effect may displace certain species of Invertebrates, Finfish and Birds with specific depth requirements that use the Nearshore habitat. While the habitat and associated endpoints would shift further offshore, it would not be eliminated. Invertebrates in the Intertidal habitat are directly impacted by the deposition of the material; Finfish and Birds that feed on Intertidal Invertebrates are locally and indirectly impacted since they no longer can access their prey. Intertidal Vegetation and Marine Mammals of the rocky Intertidal habitat of the eastern portion of the project area could also be affected by deposition. The covering of the rocks with sand will eliminate this structural dimension from the habitat.

Transitional endpoints include Vegetation, Amphibians and Reptiles, Marine Mammals and Birds. Of these endpoints, Vegetation of the Marine Beach and Dunes and Swales habitats were considered most important because of the potential presence of Sea Beach Amaranth; and Birds were most important in all four habitats because of the potential presence of Endangered and Threatened species. The placement of material on the beach may directly destroy vegetation beneath the placement area. This restructuring of the beach could also impact birds which feed or nest on the beach.

Vegetation in the Dune and Swales habitat is the only terrestrial endpoint that could potentially be affected by Beach Nourishment/Renourishment due to potential smothering of dune vegetation.

Beach scraping would have the same potential impacts as Beach Nourishment/Renourishment. Recontouring on the beach could lead to a subtle, seaward progression of the Nearshore habitat and its endpoints. Recontouring could also lead to the direct covering and elimination of Intertidal Invertebrates. Fish and Birds that use the intertidal zone for forage would be indirectly affected, albeit temporarily. Vegetation on the Marine Beach and/or Dunes and Swales habitat could be directly dislodged by the scraping activity, or covered by recontouring. This would change the habitat structure and could indirectly affect birds that utilize it.

5.1.3 Dune Modification

Description. Dune Modification can be considered a feature of Beach Nourishment/Renourishment as described above in Section 5.1.2 since it is usually performed in conjunction with recontouring of the adjacent beach area. For the purposes of the reformulation, it is assumed that this feature would typically increase the height of existing dunes to a maximum elevation of 17 feet over NGVD (National Geodetic Vertical Datum). Dune Modification includes but is not limited to, raising or lowering the height of the dune, changing the slope of the dune, increasing the width of the dune, expanding the linear extent of the dune, connecting fragmented dunes and increasing vegetative cover. In some areas, lowering of dunes can also establish a multi-dimensional mosaic dune system that allows for Cross Island Transport at that location. In addition, design elevations of new dunes may be lower than existing dunes.

Dunes provide a variety of physical and biological functions. They are an important buffer between the very active beach and the more stable interior areas, serving as a barrier against storm surge and wave penetration. As a storage bank of sand, dunes diminish the effects of erosion during extreme storm events by contributing sand to the total transport.

Dunes also provide a unique habitat at the transition (ecotone) between the exposed beach and the sheltered landward portion of the barrier island. The sparsely vegetated foredune toe habitat is the site of runners and rhizomes of pioneer vegetation, clumps of seabeach amaranth and seabeach knotweed, that provide nesting sites for a variety of shorebirds. The dune face and crest is typically colonized by dune grass, seaside goldenrod, and dusty miller, providing cover and forage for birds and insects. The leesides of dunes offer protection and are occupied by shrubs and bushes and salt-pruned trees which support insects, birds, and small mammals. Often, low areas to the lee of the foredunes are poorly drained and these dune slacks are home to freshwater pond/marsh habitats.

Barrier Island Processes. While the most obvious barrier island process affected by Dune Modification is Dune Development and Evolution, Cross Island Transport can also be potentially affected; both processes are interrelated since they are affected by availability of sediment (Table 4). While heightening can accelerate the formation of dunes, it has the effect of reducing sediment transport across the island. If this occurs on a broad scale, it can affect the formation of the natural mosaic of bayside habitats and biota that inhabit them. Dune lowering may also be considered in cases where, under the restoration alternatives, the project is seeking to improve cross-island transport thus further facilitating the necessary mosaic of all processes within the 83-mile project study area.

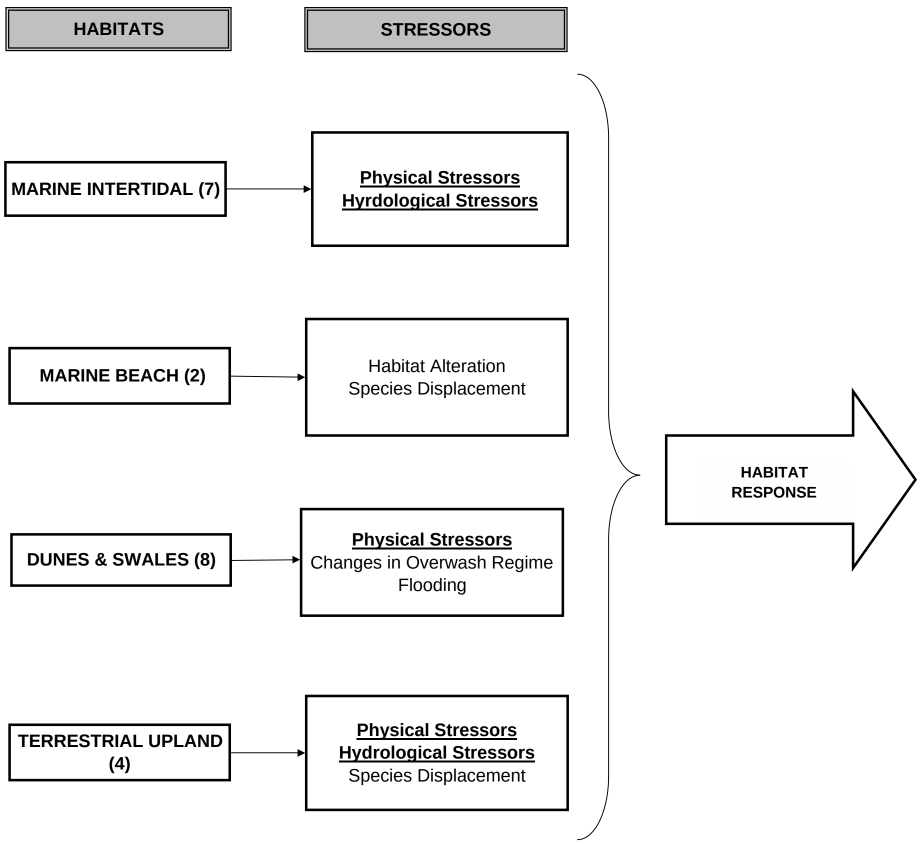
Phase 3 Model-Dune Modification. Figure 7 is the Phase 3 Model for Dune Modification. While there is no individual mosel for dune restoration, Figure 7 includes the same, relevant habitats. Construction-Soft is the driver associated with Dune Modification, since by definition Construction-Soft includes dune enhancement, plantings and other restoration measures (USACE 2004). While overall, potential impacts would likely be minimal, several endpoints from several habitats were included in the Phase 3 Model. The following four habitats could potentially be affected by Dune Modification: Marine Intertidal, Marine Beach, Dunes and Swales and Terrestrial Upland. While potential impacts of Dune Modification would be the same as constructing a dune, the impacts would be less severe. Dune Modification also includes connecting fragmented dunes to improve beach protection. In addition, while the Marine Nearshore habitat was assessed for inclusion in the model, no stressors could be linked to the driver for this habitat, and consequently, no endpoints were identified. Any potential indirect impacts to the Marine Nearshore habitat as a result of Dune Modification would be negligible.

While all three categories of endpoints could be impacted, Transitional endpoints are the most vulnerable owing to the location of the dunes. Marine Intertidal Invertebrates are the only Aquatic endpoints that use these habitats that could be affected. It is anticipated that potential impacts would be minimal and due to the progressive build up of the beach. In the Dunes and Swales habitat, Amphibians and Reptiles endpoints could be a concern due to the presence of the Diamondback Terrapin. While Terrestrial Insects were not included in the model, their presence and abundance can have an affect on endpoints using this habitat for forage.

Transitional endpoints include Vegetation, Amphibians and Reptiles, and Birds. Potential Transitional Vegetation and Transitional Birds impacts were ranked highest owing to the possibility of occurrence of the Endangered and Threatened Sea Beach Amaranth and several Threatened and Endangered Birds. The Federal Endangered Species Act and Migratory Bird Treaty Act affords protection to these endpoints. Dunes and Swales Amphibians and Reptiles were ranked second in importance owing to the possible presence and potential disturbance of the Diamondback Terrapin. While the Diamondback Terrapin was recently delisted, it is a

Figure 7
Phase 3 Conceptual Model - Dune Modification
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - DUNE MODIFICATION



HABITATS	ENDPOINTS: Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
Marine Intertidal	--	1	--	--	--	--	--	--	3	--	--	--	--
Marine Beach	--	--	--	--	--	3	--	--	3	--	--	--	--
Dunes & Swales	--	--	--	--	--	3	2	--	3	1	--	--	--
Terrestrial Upland	--	--	--	--	--	--	--	--	1	--	--	--	--

Note: The driver for Dune Modification is Construction - Soft.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

species of local interest and importance. The movement of Birds and their use of multiple habitats require that they be included in the Phase 3 Model. Potential impacts to Birds were ranked high since several Endangered and Threatened Birds frequent these habitats and are protected by the Migratory Bird Treaty Act and the Federal Endangered Species Act. Vegetation is the only Terrestrial Endpoint of potential concern and is listed in the Dunes and Swales habitat.

In addition to the endpoints that were included in the Phase 3 Model for Dune Modification, the following endpoints were considered and excluded from further consideration since they have only a slight potential to be influenced:

- All endpoints of the Nearshore habitat, including Aquatic Invertebrates, Finfish, Birds and Marine Mammals, and Transitional Amphibians and Reptiles, Marine Mammals and Birds
- Aquatic Vegetation, Finfish, Birds and Marine Mammals, along with Transitional Marine Mammals and Birds of the Intertidal habitat
- Terrestrial Mammals and Insects of the Marine Beach habitat
- Terrestrial Birds, Mammals and Insects and Amphibians and Reptiles of the Dunes and Swales habitat
- Transitional Vegetation and Amphibians and Reptiles along with Terrestrial Vegetation, Birds, Mammals and Insects and Amphibians and Reptiles, of the Terrestrial Upland habitat

Overall, the impact of Dune Modification on the Terrestrial Upland habitat is to create a more stable diverse habitat.

5.1.4 Dredging

Description. Dredging for the purpose of sand mining in the marine nearshore, or more typically, offshore area can be a component of Beach Nourishment/Renourishment (Section 5.1.2). As such, it should be considered in the assessment of potential project features. Dredging involves significant short-term disturbance to the substrate and water column in the areas where sediment is removed.

While bay dredging could provide a possible source of material from intercoastal channels and flood shoals, the bays are not typically considered a source of material and are not addressed in this section. However, it is more likely that this type of sand removal may occur in conjunction with the bypassing process (Section 5.1.6) and is thus handled separately. Additionally, the dredging of inlets will be handled through potential Federally proposed inlet interim projects (not addressed in this report) and /or Inlet Sand Bypassing (Section 5.1.6).

Barrier Island Processes. Estuarine Processes affecting sediment dependent benthic habitats in the Marine Offshore habitat can be potentially affected by Dredging (Table 4). Since the sediment substrate in the Marine Offshore zone is important habitat for infaunal and epifaunal benthic invertebrates and higher order fish consumers that rely on them as food, dredging these areas can have short-term, localized effects on populations of these organisms. These potential localized effects would be most likely to occur during and immediately following the dredging operation when sediment turbidity is particularly high. However, utilizing best management practices such as construction windows can significantly decrease these impacts.

Phase 3 Model-Dredging. In the process of dredging, the benthic macroinvertebrate community is removed along with the sediment. Natural recolonization is initiated almost immediately, but the diversity and stability of the community may not return to pre-dredging conditions for several seasons. The presence and disturbance of commercially or recreationally important species is also a concern. Suspended sediments in the water column during the dredging process also represent a short-term, localized impact that temporarily affects fish. Since fish are mobile, they can move out of the impacted area during the dredging operation. Dredging operations can also be a concern for mammals and sea turtles that can be injured or killed by the dredge. Scheduling the operation for periods when mammals and turtles are less likely to be present mitigates these potential impacts. Dredging should not be performed indiscriminately; it should be carefully scheduled to avoid enhancement of unavoidable impacts during migratory, reproductive and other sensitive periods. Temporal variability in migration, reproduction and other sensitive periods makes the scheduling aspect of dredging a critical aspect of impact minimization.

Figure 8 is the Phase 3 Model for Dredging. Construction-Dredging is the relevant driver. Offshore and Nearshore habitats could potentially be affected during dredging. For the purposes of the Phase 3 Model, the Inlets habitat is not included since Inlet dredging is on-going in the absence of the FIMP project. The dredging of Fire Island, Moriches and Shinnecock Inlets is presently federally authorized as projects separate from the larger FIMP Reformulation Project.

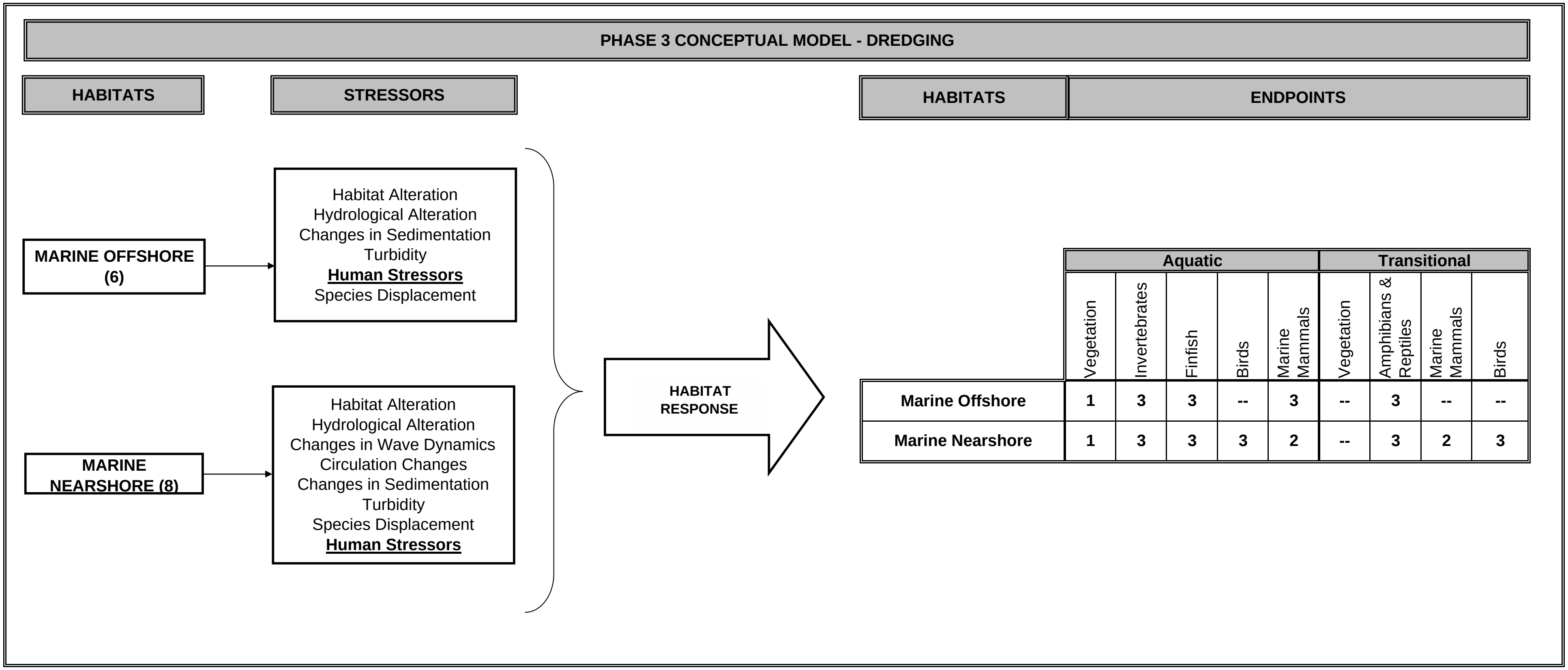
Note also, that dredging could occur in the ebb or flood shoals of the inlets, or the beach itself as a feature of Inlet Sand Bypassing (See Section 5.1.6 below). Many of the same endpoints (eg., Invertebrates, Finfish, and Birds for the shoals, and Vegetation, Birds and Terrestrial Mammals and Insects for the Marine Beach) could be affected.

Aquatic endpoints that use these habitats that could be affected include Vegetation, Invertebrates, Finfish, Birds and Marine Mammals. With the exception of Vegetation and Marine Mammals in the Nearshore area, potential impacts to all endpoints are given the highest importance owing to the presence of Essential Fish Habitat and Endangered and Threatened birds. The Marine Mammal Protection Act, and the Federal Endangered Species Act afford additional protection to these endpoints.

As discussed above, impacts include total removal of the benthic community. Since a variety of species are commercially and recreationally important (eg., Clams, Lobster, Squid, Ocean Quahog), the Invertebrates in both the Offshore and Nearshore habitat are particularly vulnerable. Removal of the benthos indirectly impacts Fish that feed on the bottom. Birds in the Nearshore may also be impacted. Fish may be impacted directly by the dredging operation, and indirectly by removal of their food source. While the benthic community will recover naturally, it will take years for it to return to its pre-dredge condition.

Transitional endpoints include Amphibians and Reptiles, Marine Mammals and Birds. Since effects of dredging are mostly associated with the substrate, organisms that live in, on or near the bottom could be impacted. Invertebrates and Finfish are of greatest concern owing to the presence of Essential Fish Habitat. Examples of invertebrates include the Ocean Quahog, Surf Clam and Squid; the Bluefish is an example of a fish species that is on the list of Essential Fish Habitats.

Figure 8
Phase 3 Conceptual Model - Dredging
Fire Island Inlet to Montauk Point



	Aquatic					Transitional			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds
Marine Offshore	**1**	**3**	**3**	**--**	**3**	**--**	**3**	**--**	**--**
Marine Nearshore	**1**	**3**	**3**	**3**	**2**	**--**	**3**	**2**	**3**

Note: The driver for Dredging is Construction - Dredging.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

5.1.5 Bulkhead/Seawall

Description. A bulkhead is a steep or vertical structure supporting a natural or artificial embankment. Bulkheads can be made of timber, concrete, masonry, steel or timber sheet piling, etc., and may be used for toe protection in combination with revetment (rock). In bank and shore protection, a bulkhead is an armoring device on a steep slope that retains the bank against sliding or erosion. Bulkheads are normally constructed with a vertical face, maximizing wave reflection. Scour can be controlled by providing an environmentally sound engineering design that includes toe protection to the base of the constructed wall.

Seawalls are sloped structures typically constructed of a rubble core covered by large stone. Placement of the structure on the landward side of the berm limits the wave reflection. The structure could also be buried under sand where impacts would be similar to dune construction (Section 5.1.3).

Due to the potential for extreme environmental impact associated with the construction of bulkheads and seawalls, it is highly unlikely that they would be built under the FIMP Reformulation Project. However, since potential associated impacts must be included for completeness, these features are included in the Conceptual Model, and this section will apply bulkhead and seawall construction on both the ocean and bay habitats.

Barrier Island Processes. Bulkhead/seawall removal or construction has the potential to affect the barrier island processes of Longshore Transport, Cross Island Transport, Bayside Shoreline Processes and Dune Development and Evolution (Table 4). Under the Bulkhead/Seawall construction category, these structures can increase the amount of scour and result in redistribution of material into bay habitats if adequate environmental controls are not included in the design. Similarly, trapping of sediments by these structures can reduce the amount of material available for transport. In both instances, all four processes can be altered.

Bulkheadding (or seawall construction) on the bayside can prevent landward and upward migration of beaches, flats and salt marshes; effecting Cross Island Transport. In reverse, bulkhead removal on the bayside can help restore this process as well as Bayside Shoreline Processes to a more natural shoreline profile by allowing sediment transport along the shoreline facilitating establishment of a diverse, gradual intertidal zone that includes both mud flats and emergent marsh. This more natural profile provides habitat for juvenile fish and invertebrate species, along with feeding and resting areas for waterfowl.

Phase 3 Model-Bulkhead/Seawall. Depending upon where the bulkhead is constructed, bulkhead construction may stabilize the terrestrial (upland) habitat, but eliminate the natural profile and hydrology of the intertidal zone. Bulkhead or seawall construction can eliminate benthic infaunal invertebrates but these species may be replaced with attached forms. Additionally, fish habitat is significantly reduced and/or altered and vegetation may be altered or eliminated. Construction of bulkheads can also create a barrier that prevents normal upland migration associated with terrapin nesting.

Figure 9 is the Phase 3 Model addressing Bulkhead/Seawall activities. Construction-Hard is the driver associated with Bulkhead Construction since it involves the placement of engineered structures to maintain surfaces. While it is unlikely that any hard structures, such as bulkheads or seawalls, will be built as a result of the Reformulation Project, all potential storm damage reduction project features must be evaluated to assess impacts. Hard structures such as bulkhead would be considered only when the less intrusive features of management options, non structural, and "soft" construction were deemed unsuitable to provide necessary levels of storm damage reduction.

For the purposes of the Reformulation Study, the bulkhead alternative would be considered on the oceanside of the barrier islands, and on the bayside of the barrier island along inlets and the adjacent bayside shorefronts within the inlet circulation system. Bulkheads placed or extended along bayside shorelines would serve to reduce breaching and erosion effects occurring from the bayside, due to inlet-related circulation patterns.

The following five habitats could potentially be affected by activities associated with Bulkhead/Seawall: Marine Nearshore, Marine Intertidal, Marine Beach, Dunes and Swales and Terrestrial Upland. While the Marine Nearshore habitat is fairly removed from the intertidal zone where the bulkhead or seawall would be constructed, it could be affected by scour, increased turbidity and changes in beach patterns.

All three categories of endpoints could be impacted. Aquatic endpoints that use Marine Nearshore and Marine Intertidal habitats that could be affected include Vegetation, Invertebrates, Finfish, Turtles, and Birds. With the exception of Nearshore Vegetation and Intertidal Invertebrates, impacts to all of these endpoints are considered important due to the presence of potential Essential Fish Habitat and Endangered and Threatened species. Birds could be indirectly affected by potential impacts to prey items on which they feed. The nature of the invertebrate community in the intertidal zone is especially susceptible to the placement of bulkheads. Typical sediment-dwelling forms (eg., polychaetes, amphipods, oligochaetes) are replaced with attached, epibenthic forms (eg., barnacles, mussels, coelenterates). Turtles may be impacted by bulkhead construction because the structures could prevent their normal upland migration associated with nesting. Fish and Birds that feed on the Benthic Invertebrates are indirectly impacted. Fish can also be directly impacted by removal of their habitat.

Since the construction of bulkheads or seawalls interrupts the contiguous nature of adjacent habitats, Transitional endpoints that use multiple habitats would be particularly vulnerable. Transitional endpoints include Vegetation, Amphibians and Reptiles, and Birds. All four Terrestrial endpoints including Vegetation, Birds, Terrestrial Mammals and Insects and Amphibians and Reptiles can also be potentially impacted. Of these endpoints, Transitional Birds are potentially at the greatest risk since they use all five habitats, and include protected species such as the Piping Plover. Bulkhead construction can positively impact terrestrial areas by creating stability. All of the Terrestrial endpoints of the Dunes and Swales habitat, along with Marine Beach Mammals and Invertebrates, are potentially impacted by Bulkhead construction.

In addition to the endpoints that were included in the Phase 3 Model for Bulkhead/Seawall, the following endpoints were considered and excluded from further consideration since they have only a slight potential to be influenced by this feature. Note that for the purposes of the Conceptual Model, Aquatic Marine Mammals refers to marine mammals that depend solely on aquatic habitats, while Transitional Marine Mammals refers to those species that rely on both aquatic and terrestrial habitats:

- Aquatic Marine Mammals, and Transitional Amphibians and Reptiles and Marine Mammals of the Nearshore habitat

Figure 9
Phase 3 Conceptual Model - Bulkhead/Seawall
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - BULKHEAD/SEAWALL

HABITATS	STRESSORS
MARINE NEARSHORE (5)	Habitat Alteration Hydrological Alteration Changes in Wave Dynamins Circulation Changes Changes in Sedimentation
MARINE INTERTIDAL (10)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors**
MARINE BEACH (10)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors**
DUNES & SWALES (11)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors** Salt Deposition
TERRESTRIAL UPLAND (7)	**Physical Stressors** Changes in Overwash Regime Flooding Salt Deposition Species Displacement **Human Stressors**

HABITAT RESPONSE

HABITATS | **ENDPOINTS**

	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
Marine Nearshore	**1**	**3**	**3**	**3**	**--**	**--**	**3**	**--**	**3**	**--**	**--**	**--**	**--**
Marine Intertidal	**--**	**1**	**3**	**3**	**--**	**--**	**--**	**--**	**3**	**--**	**--**	**--**	**--**
Marine Beach	**--**	**--**	**--**	**--**	**--**	**3**	**--**	**--**	**3**	**--**	**--**	**2**	**--**
Dunes & Swales	**--**	**--**	**--**	**--**	**--**	**3**	**2**	**--**	**3**	**1**	**3**	**2**	**2**
Terrestrial Upland	**--**	**--**	**--**	**--**	**--**	**2**	**2**	**--**	**2**	**--**	**--**	**--**	**--**

Note: The driver for Bulkhead/Seawall is Construction - Hard.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

- Aquatic Vegetation and Marine Mammals, along with Transitional Marine Mammals of the Intertidal habitat
- All Terrestrial endpoints of the Terrestrial Upland habitat

Since it is highly unlikely that bulkheads would be considered on the ocean side, potential impacts to sea turtles or terrapins are not included in the model. It is noteworthy, however, that ocean side bulkhead construction would prevent normal upland migrations associated with nesting since terrapins are known to approach beaches from the ocean.

Please note that there is also the possibility of removing bulkheads/seawalls along the bayside shoreline within the FIMP project study area. For associated impact assessment please refer to Section 5.1.11, Bayside Shoreline.

5.1.6 Inlet Sand Bypassing

There are no specific features proposed solely for Inlets, however, components that affect Inlets are included in other models and project components. The reader is referred to the following models for this information:

- Groin Alteration and Construction, (e.g., T-groin); Figures 4 and 5
- Bulkhead/Seawall Construction; Figure 9
- Inlet Sand Bypassing; Figure 10 (and covered in this section)

Description. Inlet Sand Bypassing is the hydraulic or mechanical movement of sand, from an area of accretion to a downdrift area of erosion, across a barrier to natural sand transport such as large scale harbor or jetty structure. The hydraulic movement may include natural movement as well as movement caused by man. Inlet Sand Bypassing includes sand placement and sand removal as well as all other associated project needs.

Stabilized or unstabilized tidal inlets represent perturbations to the continuum of littoral drift. Areas updrift (or east in the study area) may be subject to accretion as incoming longshore sediment transport is trapped by a jetty. A portion of longshore sediment transport entering the inlet will also be distributed into shoals that form within the inlet. The remaining portion of longshore sediment transport will bypass the inlet and nourish downdrift beaches. Trapping of longshore sediment transport, either updrift or within the inlet, may create sediment transport deficits downdrift, resulting in shoreline erosion. Since the erosion is partly due to sediment trapping caused by the inlet, measures to enhance/restore littoral drift across the inlets (Inlet Sand Bypassing) would benefit sediment transport and help stabilize habitat.

Barrier Island Processes. Inlet Sand Bypassing is considered to be the only project feature with the potential to affect all barrier island processes, including Longshore Transport, Cross Island Transport, Dune Development and Evolution, Bayside Shoreline Processes and Estuarine Processes (Table 4). Since inlets facilitate sediment transport from the ocean side to the bayside, all natural barrier island sediment transport process will be modified to some degree by these features. Inlet sand bypassing seeks to maintain Longshore Transport rates, as a result it is not anticipated that hydrodynamics will be affected. Cross Island Transport is heavily influenced by the existence of inlets. The availability of more sediment will affect the development of sediment-dwelling communities (ie., benthos) and the higher order consumers that rely on this food source.

Phase 3 Model-Inlet Sand Bypassing. Mechanical Inlet Sand Bypassing enhances the natural process of moving sand from the updrift side of the inlet to the downdrift side. It involves the placement of sand dredged from a variety of locations.

Inlet Sand Bypassing may occur at Shinnecock, Moriches and Fire Island Inlets. Features will vary depending on the inlet but may include:

- Channel, ebb and flood shoal, nearshore/updrift Beach dredging
- Fixed or Mobile bypassing plant
- Sand placement

The two aspects of Inlet Sand Bypassing are sand removal and sand placement. The sand removal component is addressed in Figure 10, Bypass Sand Removal. Since the components of sand placement associated with Inlet Sand Bypassing are the same as Beach Nourishment/Renourishment, Figure 6 would also apply. These two models (ie., Bypass Sand Removal and Beach Nourishment/Renourishment) combined represent all potential pathways associated with Inlet Sand Bypassing.

The driver of Inlet Sand Bypassing is Construction-Dredging. Since the primary components of the Inlet Sand Bypassing feature includes Dredging, sand removal, and sand placement a separate model was not developed. Instead, the existing Phase 3 Models will apply depending upon the inlet specific feature design. Dredging associated with Inlet Sand Bypassing occurs in areas other than those associated with offshore dredging (e.g., nearshore, the ebb shoal of the inlet, or channel), and hence potentially affects other endpoints. The following four habitats could potentially be affected by this driver: Marine Intertidal, Marine Beach, Bay Subtidal, and Inlet.

Aquatic and Transitional endpoints could be impacted by Inlet Sand Bypassing. Aquatic endpoints that use Marine Intertidal, Marine Beach, Bay Subtidal, and Inlet habitats that could be affected include Invertebrates, Finfish, and Birds. The aquatic birds that inhabit the Marine Intertidal were ranked highest owing to the possibility of occurrence of Endangered and Threatened species. Birds could be indirectly affected by potential impacts to prey items on which they feed. Fish and Invertebrates can also be impacted by this feature.

Transitional endpoints include Vegetation, Amphibians and Reptiles, and Transitional Birds. These Transitional endpoints are of greatest concern owing to the potential presence of Threatened and Endangered Species. Dredging associated with Inlet Sand Bypassing has the potential to destroy temporary terrapin habitat and/or kill terrapins if it is performed during the months of October through April when terrapins may be present. Since it is highly unlikely that bay dredging will occur as part of the project, it is not likely that terrapins would be impacted. If dredging does occur, it would be performed from May to September, when the terrapins are not present so as to avoid any impacts to this species.

Since material will only be removed from the ebb or flood shoals in proximity to the inlets, therefore, only shoal species utilizing this area could be potentially impacted. Invertebrates, Finfish, and Birds that utilize the shoals, and Vegetation and Birds utilizing the Marine Beach and Marine Intertidal could be affected.

Figure 10
Phase 3 Conceptual Model - Inlet Sand Bypass
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL -INLET SAND BYPASS

HABITATS | **STRESSORS**

DRIVER: CONSTRUCTION - DREDGING

MARINE INTERTIDAL (6) →
Habitat Alteration
Hydrological Alteration
Changes in Wave Dynamics
Circulation Changes
Changes in Sedimentation
Species Displacement

MARINE BEACH (4) →
Habitat Alteration
Hydrological Alteration
Changes in Wave Dynamics
Species Displacement

BAY SUBTIDAL[(1)] (4) →
Habitat Alteration
Changes of Sedimentation
Turbidity
Species Displacement

INLET (9) →
Habitat Alteration
Hydrological Alteration
Circulation Changes
Changes in Sedimentation
Changes in Nutrient
Concentrations
Contaminants
Turbidity
Species Displacemnet
<u>Human Stressors</u>

HABITAT RESPONSE →

HABITATS | **ENDPOINTS**

	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
CONSTRUCTION - DREDGING													
Marine Intertidal	--	1	--	3	--	--	--	--	3	--	--	--	--
Marine Beach	--	--	--	--	--	3	--	--	3	--	--	--	--
Bay Subtidal[(1)]	--	1	--	--	--	--	--	--	--	--	--	--	--
Inlet	--	2	2	--	--	--	3	--	--	--	--	--	--

Note: The driver for Inlet Sand Bypass is Construction - Dredging.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
(1)Since sand will only be removed from the ebb and flood shoals in proximity to the inlet, only shoal species are considered.

Inlet Sand Bypassing mitigates beach erosion caused when dredged navigation channels disrupt nearshore sand movements. Nearby downdrift beach profiles are maintained, and habitats protected by this measure. All endpoints dependent upon these habitats would be positively affected.

5.1.7 Nonstructural Features

Description. In addition to the structural approaches to storm damage reduction discussed in the preceding paragraphs, the Reformulation Study also includes the identification and evaluation of "nonstructural" methods of storm damage reduction. Nonstructural features are intended to reduce damages to existing buildings and infrastructure and future development without significantly interfering or altering the physical coastal processes of flooding or erosion. These nonstructural activities can occur on the barrier island or mainland. For example, flood-prone buildings can be raised, retrofitted, or relocated. Alternatively, in some bayside areas it may be more cost effective to raise a roadway on the bayside of a group of homes to act as a 'levee'. In some cases, voluntary acquisition of vulnerable buildings and land on the barrier island or mainland may be desirable. Buying and relocating structures also provides restoration opportunities on the barrier island or mainland by allowing natural habitat growth of currently developed areas. In addition, there are numerous regulatory and management features, such as zoning and construction standards, that are effective in limiting risks to future development and redevelopment.

The following Nonstructural Features were identified by federal, state, and local interests and evaluated for their ability to meet the storm damage reduction and environmental enhancement goals of the Reformulation Study. Note, as discussed above, these features are relevant to both the barrier island and the mainland:

Land Use/Regulatory:
Zoning and Land Use Controls, New Infrastructure Controls, Landform/Habitat Regulation, Construction Standards, Construction Practices, Insurance Program Modification, Tax Incentives

Building Retrofit:
Relocation, Elevation, Free-Standing Barriers, Dry Flood-Proofing, Utilities Protection, Levees

Land Acquisition:
Purchase of Property, Exchange of Property, Transfer of Development Rights, Easements and Deed Restrictions

Restoration :
Wetlands Protection and Restoration, Vegetative Stabilization

With the exception of Insurance Program Modifications, all of these project features were recommended for further evaluation. In addition, New Infrastructure Controls, Free-Standing Structures, and Dry Floodproofing features were eliminated from further review on the barrier island because they would not effectively accomplish the study objectives.

A Phase 3 Model (Figure 11) was developed for Structure Elevation and/or Relocation since it, or a combination of many nonstructural measures, may be included as a potential project alternative under the FIMP Reformulation Project. Other nonstructural project features related to

Restoration Measures (eg., Upland Restoration, Section 5.1.7; Island Restoration, Section 5.1.8; Plantings and Invasive Species Control, Section 5.1.9; Bayside Shoreline Processes, Section 5.1.11; Tidal Marsh Restoration, Section 5.1.12; and SAV Restoration, Section 5.1.13) are addressed in subsequent portions of this section. In addition, a separate Phase 3 Model was developed for Mainland Restoration, since nonstructural features can also apply on the mainland (Figure 12).

Barrier Island Processes. On a very small scale, Structure Elevation and/or Relocation has the potential to affect the barrier island processes of Longshore Transport, Cross Island Transport and Dune Development and Evolution (Table 4). By removing these homes, the barrier island in this location will be naturally restored to a pre-development condition. As such, Longshore and Cross Island Transport can be restored in these areas and dunes can grow and evolve. All associated species that use and benefit from these processes will also show improvements in concert with these physical changes as a result.

Phase 3 Model-Nonstructural Features. Figure 11 is the Phase 3 Model for Structure Elevation and/or Relocation. This model addresses structure raising only on the barrier island, however since house raising is likely to occur on the mainland it is further addressed in this and the “Upland Restoration” Section 5.1.8, and in the model for Mainland Restoration (Figure 12). This is one of the few models where two drivers induce stressors; Development and Construction-Hard. Additional associated project components, such as habitat enhancement and restoration are covered by other models (e.g., Figure 15, Tidal Marsh Restoration).

By definition, the Terrestrial Upland is the only habitat that could potentially be affected in the restoration of mainland areas. The Development driver is included because it relates to buildings, marinas and roads. Construction –Soft addresses structural removal and habitat restoration, such as would be the case by raising a building off of the beach or dune area. The following four habitats could potentially be affected by Building Elevation and/or Relocation under either driver: Marine Intertidal, Marine Beach, Dunes and Swales and Terrestrial Upland.

Potential endpoints are the same regardless of the driver considered. The Marine Intertidal habitat is the only habitat where Aquatic endpoints are influenced. There are three Aquatic endpoints potentially affected, but Aquatic Birds are considered most important since they include Endangered and Threatened species. Intertidal vegetation would only apply to the rocky Intertidal where the hard substrate provides a surface for attachment.

Transitional and Terrestrial endpoints are the endpoints of greatest potential concern. Transitional endpoints are the most susceptible to Building Elevation and/or Relocation. Transitional endpoints include Vegetation, Amphibians and Reptiles, and Birds. Vegetation endpoints were highly ranked in the Marine Beach and Dunes and Swales habitat owing to the potential presence of Sea Beach Amaranth. Highest-ranking (3) Transitional and Terrestrial endpoints include Amphibians and Reptiles and Birds. This ranking is attributable to the potential presence of the endangered Mud, Box and Spotted Turtles, and Hawks and Osprey in the habitats. Most of the Terrestrial endpoints are associated with the Terrestrial habitat and include Terrestrial Vegetation, Birds, Mammals and Insects and Amphibians and Reptiles.

In addition to the endpoints that were included in the Phase 3 Model for Building Elevation and/or Relocation, the following endpoints were considered and excluded from further consideration since they have only a slight potential to be influenced:

Figure 11
Phase 3 Conceptual Model - Structure Elevation and Relocation
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - STRUCTURE ELEVATION AND RELOCATION

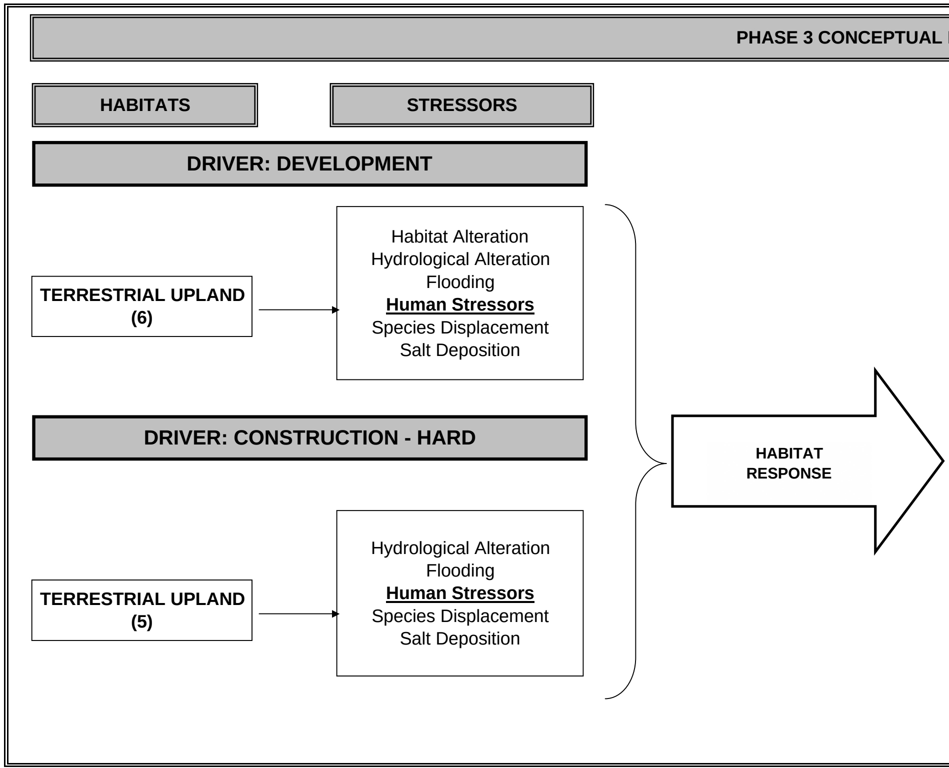
HABITATS	STRESSORS
DRIVER: DEVELOPMENT	
MARINE INTERTIDAL (5)	Habitat Alteration Hydrological Alteration Changes in Sedimentation Species Displacement **Human Stressors**
MARINE BEACH (4)	Habitat Alteration Changes of Sedimentation Species Displacemnet **Human Stressors**
DUNES & SWALES (4)	Habitat Alteration Species Displacement **Human Stressors** Salt Deposition
TERRESTRIAL UPLAND (4)	HabitatAlteration Salt Deposition Species Displacement **Human Stressors**
DRIVER: CONSTRUCTION - SOFT	
MARINE INTERTIDAL (4)	Habitat Alteration Changes in Sedimentation Species Displacement **Human Stressors**
MARINE BEACH (4)	Habitat Alteration Changes of Sedimentation Species Displacemnet **Human Stressors**
DUNES & SWALES (4)	Habitat Alteration Changes in Sedimentation Species Displacement **Human Stressors**
TERRESTRIAL UPLAND (3)	HabitatAlteration Species Displacement **Human Stressors**

HABITAT RESPONSE

HABITATS	ENDPOINTS												
	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
DEVELOPMENT & CONSTRUCTION SOFT													
Marine Intertidal	**1(1)**	**1**	--	**3**	--	--	--	--	**3**	--	--	--	--
Marine Beach	--	--	--	--	--	**3**	--	--	**3**	--	--	**2**	--
Dunes & Swales	--	--	--	--	--	**3**	**2**	--	**3**	--	--	--	--
Terrestrial Upland	--	--	--	--	--	**2**	**2**	--	**2**	**2**	**3**	**1**	**3**

Note: The drivers for Structure Elevation and Relocation are Development and Construction - Soft.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
(1)Vegetation endpoints for the Intertidal Habitat refers to Rocky Intertidal Habitat only.

Figure 12
Phase 3 Conceptual Model - Mainland Restoration
Fire Island Inlet to Montauk Point



HABITATS	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
Terrestrial Upland	--	--	--	--	--	1	3	--	3	1	3	1	3

Note: The drivers for Mainland Restoration are Development and Construction - Hard.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
Endpoints for model were taken from Table 2.

- Aquatic Finfish, Birds and Marine Mammals, and Transitional Marine Mammals of the Intertidal habitat
- All Terrestrial endpoints of the Dunes and Swales habitat

Overall, potential impacts associated with Building Elevation and/or Relocation are positive since this features allows a developed habitat to return to its natural condition. Relocation can also provide opportunities for habitat restoration in dunes, uplands, tidal marshes or other developed sensitive areas.

5.1.8 Upland Restoration

Features that include habitat restoration or enhancement in upland areas are referred to as Upland Restoration. Upland Restoration includes any work on upland portions of barrier islands and adjacent bay islands such as restoration by vegetation planting, alteration of elevation, habitat use changes, or as a result of structural removal (Section 5.1.7). In areas where restoration may replace poor quality or developed areas, ecological benefits will accrue to endpoints associated with the newly formed habitats.

An example of Upland Restoration might be removal of structures (houses, bulkheads etc.) and establishment of natural vegetation to provide habitat to upland species and improve the mosaic habitats of the barrier island. Another example might be allowing undeveloped upland areas on both the barrier and bay islands to revert to successional communities.

Barrier Island Processes. Barrier island processes potentially affected by Upland Restoration include Cross Island Transport and Dune Development and Evolution (Table 4). By restoring the upland communities these processes will naturally be allowed to restore and, over time, contribute to the mosaic of habitat and community types found within the project area. For example, if houses and structures are removed, and the remaining land is left vacant, Cross Island Transport will more likely occur. Similarly, dunes will grow and evolve when structures are removed from disturbed dune communities; eventually a natural vegetation and slope will become established.

Phase 3 Model-Upland Restoration. Figure 13 is the Upland Restoration. The model applies to any component affecting the upland barrier island, upland portions of bay island(s) or the upland portion of the mainland associated w/ the project. The driver for Upland Restoration is Construction-Soft since it can involve the removal of structures and other man made features.

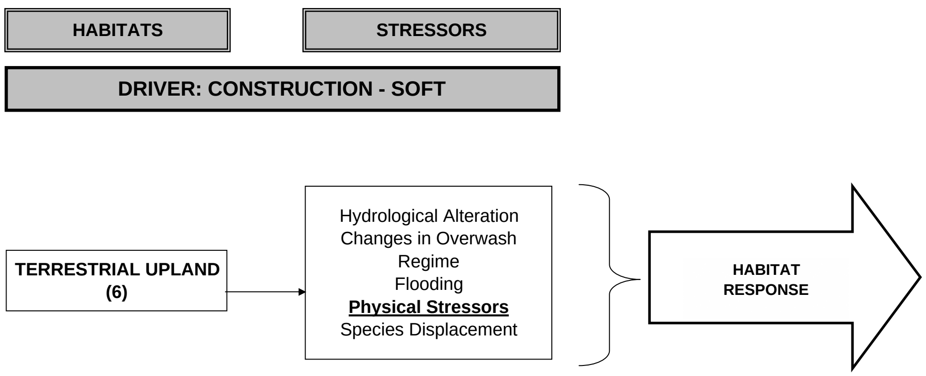
The Terrestrial Upland is the only habitat that is included in the model. Stressors are primarily from the Hydrological Category of stressors but also include all Physical Stressors. With the exception of Marine Mammals, all Transitional and Terrestrial endpoints are included in the model. The highest ranking endpoints are Transitional and Terrestrial Amphibians and Reptiles and Birds; largely due to the presence of endangered and threatened species.

5.1.9 Island Restoration

Definition. Island Restoration may include habitat restoration or enhancement in upland or shoreline areas of dredge spoil islands. The preceding section (5.1.8) covered the upland portion of this restoration therefore that section, in conjunction with this section, should be used for all Island Restoration assessments.

Figure 13
Phase 3 Conceptual Model - Upland Restoration
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - UPLAND RESTORATION



HABITATS	ENDPOINTS												
	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
CONSTRUCTION - SOFT													
Terrestrial Upland	--	--	--	--	--	1	3	--	3	1	3	1	3

Note: The driver for Upland Restoration is Construction - Soft.

Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.

Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.

Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

Model applies to any component affecting the upland barrier island or upland mainland.

An example of Island Restoration might be recontouring of an upland area of a dredge spoil disposal area to enhance hydrology, thus increasing bird habitats, decreasing invasive species that may develop over time, and the creation of wetlands along the shorelines. Another example might be the establishment of rookeries in areas where natural habitats for indigenous bird species have been eliminated.

In all cases, the islands selected for potential work were created mainly as dredge material disposal islands and as such, are already considered disturbed. Where restoration may replace poor quality dredge spoil areas, ecological benefits will accrue to endpoints associated with the newly formed habitats.

Barrier Island Processes. All barrier island processes can be affected by Island Restoration depending upon the specific work to be done (Table 4). For example, if the upland portion of the island were to be restored both Cross Island Transport and Dune Growth and Evolution processes would be improved. Also, in the event of a tidal marsh restoration or enhancement along the shorelines of these islands, the Estuarine Processes would also improve.

Phase 3 Model-Island Restoration. A separate model for Island Restoration was not developed, since any activity that falls under this category is likely to involve habitats for which models have been developed or accounted for elsewhere (e.g. Tidal Marsh Restoration Figure 15, Dune Modification Figure 7). For example if the Island Restoration selected under the FIMP Reformulation Project were to decrease elevations upon the upland portion of the island, remove vegetative cover and enhance existing tidal marsh communities the following models would be incorporated into the assessment: Upland Restoration (Section 5.1.8 and associated Figure 13), Plantings and Invasives Species Control (Section 5.1.10 and relevant models for Tidal Marsh Restoration, Figure 15, and Upland Restoration, Figure 13) to include all associated restoration impacts.

5.1.10 Plantings and Invasive Species Control

Definition. The restoration feature of Plantings and Invasive Species Control is similar to Island Work in that it can include habitat restoration or enhancement in both upland and shoreline areas. The combination of Invasive Species Control and subsequent planting of more desirable species will result in ecological benefits to endpoints associated with the newly formed habitats. Increased structural diversity of the habitat will attract a greater variety of wildlife and birds for nesting and forage.

A variety of Invasive Species Control methods are currently applied in the field and are met with varying degrees of success depending upon the size and location of the area, the species of interest and budgetary constraints. Examples include:

- Hydrological alteration. Water intolerant forms such as *Phragmites* can be controlled by changes in hydrology through contouring or channeling.
- Shading. Species intolerant of shade (eg., *Phragmites*) can be eliminated from small areas through strategic planting of fast-growing woody species.
- Introduction of predators. Certain invasives (eg., Purple Loosestrife) have been controlled through introduction of beetle larvae that nest in and feed on the inflorescense, ultimately killing the plant.

- Chemical treatment. Chemicals such as glyphosate are used as a control measure for a variety of species. Chemicals can be applied through aerial application, hand spraying or wiping individual stems.
- Controlled burning. In large areas, controlled burns are used in conjunction with other measures such as herbicide treatment to eliminate invasive species and allow move favorable forms to become established.
- Disking. For large tracts, disking is also used in combination with burning or chemical treatment as a control method. Rhizomes are disked into the ground, retarding or destroying potential for re-establishment in subsequent seasons.

For example, a *Phragmites* control program such as those described above may be implemented in tracts where *Phragmites* has colonized and out-competed more desirable vegetation forms with greater wildlife value. The type of control would depend on the nature of the area to be treated. As discussed in the previous section, invasives control is an important component of many restoration activities. *Phragmites* control is an important feature for restoration of dredge spoil islands because invasive species typically colonize these already disturbed areas. Planting more favorable species, with a higher wildlife value would be a positive impact. The upland habitat could be changed from a low value, monotypic stand of *Phragmites*, to an ecologically more valuable wetland. The Great Gun Tidal Marsh is currently 50% *Phragmites* dominated. Eradicating this invasive species and replacing it with plants of a higher wildlife value (such as *Spartina alterniflora or Spartina patens*, local tidal marsh species) would provide enhanced habitat for endpoints using the marsh.

Barrier Island Processes. Barrier island processes potentially affected by Plantings and Invasive Species Control include all processes with the exception of Longshore Transport (Table 4). Areas naturally influenced by Cross Island Transport of sediments may serve as enhancement sites to facilitate this process. Limited re-contouring and restoration of tidal marshes at the *Spartina/Phragmites* interface would also allow tidal flushing and facilitate expansion of *Spartina* marsh thus improving the Bayside Shoreline and/or Estuarine Process(es).

Phase 3 Model-Plantings and Invasive Species Control. A separate model for Plantings and Invasive Species Control was not developed, since any activity that falls under this category is likely to involve habitats for which models have already been developed or accounted for including:

- Tidal Marsh Restoration
- Upland Restoration

For example, any potential tidal marsh restoration would likely involve Invasive Species Control since this would increase the biodiversity of the tidal marsh and increase success rates of enhancement and sustainability. Similarly, Upland Restoration is largely associated with control of less desirable vegetation forms and planting species with a higher wildlife value will also result in increased biodiversity and associated species usage.

5.1.11 Bayside Shoreline

Description. The natural shore of bays is characterized by narrow marine beaches, tidal creeks, mud and sand tidal flats, tidal marshes and eelgrass beds. These beaches, tidal wetlands and shallows are natural features that contribute to barrier island integrity, buffer the upland from bay wave action and are integral to maintenance of the diversity of the natural system in the face of rising sea level.

Bayside Shoreline Processes establish habitats that are essential to the overall system functioning. Bayside beaches, tidal flats, tidal marshes, and in-shore SAV beds provide fish and wildlife nursery, spawning, and feeding habitat. These habitats support diverse populations of fish and wildlife and support most life stages of fish, crabs, and other invertebrates that are essential components of the food web. These habitats also support migratory and resident shorebirds and wading birds, diamond-backed terrapins, horseshoe crabs, hard and soft shell clams, prey fish such as mummichogs and other killifish, shrimp, northern puffers, and recreationally and commercially important finfish species. Marshes also contribute to water quality, by providing filtration services, absorbing nutrients and capturing pollutants from the uplands.

Human activities have directly and indirectly impacted the bay shoreline processes and habitats, and have impaired the ability of beaches, marshes, tidal flats, and eelgrass to function as natural and protective features. These changes are primarily a result of dredging and placement of material, and through stabilization of the bay shorelines with hard structures such as bulkheads and seawalls.

There are many examples of bayside shoreline restoration measures under consideration. One example, the potential removal of bulkheading in Bayside Shoreline areas, will restore the natural profile and habitats in these areas.

Barrier Island Processes. The restoration of Bayside Shoreline Processes has the potential to affect both Bayside Shoreline and Estuarine Barrier Island Processes (Table 4). Since Bayside Shoreline restoration is targeted at a limited area, the effects will be localized improvements in water circulation patterns that will also affect sediment transport. However, these improvements could have a significant positive cumulative impact on Bayside Shoreline Processes.

Phase 3 Model-Bayside Shoreline. Restoration of Bayside Shoreline Processes is focused on all eroded and/or altered shorelines within the backbay of the study area. However, there are a few specific areas such as the area adjacent to the Fire Island National Seashore in the vicinity of the marina areas of the Maritime Forest, and the areas immediately east of the Fire Island Pines community, that are receiving additional attention due to their National Park designations. In these two areas, as well as all other shorelines in the backbay, potential restoration activities include removal or management of invasive species such as *Phragmites*, restoration of tidal marsh(es), removal of hard structures and recontouring of associated intertidal bay sediments.

Figure 14 is the Phase 3 Model for Bayside Shoreline. Construction-Soft is the driver associated with these restoration activities since they involve removing a ‘hard’ or engineered structure. As discussed in Section 5.1.5 Bulkhead/Seawall, bulkhead removal can restore natural hydrology and sediment transport to enhance biota in the intertidal and adjacent zones.

The following three habitats could potentially be affected by alteration of the Bayside Shoreline: Bay Intertidal, Bay Subtidal and Bayside Beach. Since Sand Shoals and mud flats, SAV, and Tidal Marsh cannot persist in heavily eroded areas, these habitats have not been included in the model.

Bayside Shoreline Processes are largely hydrologically driven and affect sediment transport, that subsequently affects habitat quality and biota that use these habitats. Hence, most of the stressors of concern for this model relate to hydrology, sediment, and species and habitat characteristics.

Aquatic endpoints that use the Bay Intertidal, Bay Subtidal and Bayside Beach habitats that could be affected by the restoration of the Bayside Shoreline Processes include Vegetation, Invertebrates, Finfish, and Birds. Transitional endpoints of Vegetation, Amphibians and Reptiles and Birds are also included in the model. Birds and Amphibians and Reptiles are given the most importance in the model owing to the potential presence of the Piping Plover, Least Tern and Diamondback Terrapin.

Aquatic Vegetation, Invertebrates and Finfish endpoints in the Phase 3 Model are ranked of moderate importance due to the potential presence of Essential Fish Habitat. The Migratory Bird Treaty Act also affords protection to this endpoint. Any positive affect on Bayside Shoreline Processes that affects prey availability (eg., invertebrates and fish) would also affect Birds.

The Terrestrial endpoint of Birds is the only endpoint in this category included in the development of the Phase 3 Model for Bayside Shoreline Processes. Birds are considered of high importance in this model due to the potential presence of several endangered and threatened species including Hawks and Osprey, along with the Piping plover and Common and Least Terns.

5.1.12 Tidal Marsh Restoration

Description. Tidal marshes are transitional areas in the intertidal zone of the bayside shoreline. Because tidal marshes are influenced by the twice daily rise and fall of tides, they are subject to rapid changes in salinity, temperature and water depth, and as such, can represent naturally stressful habitat.

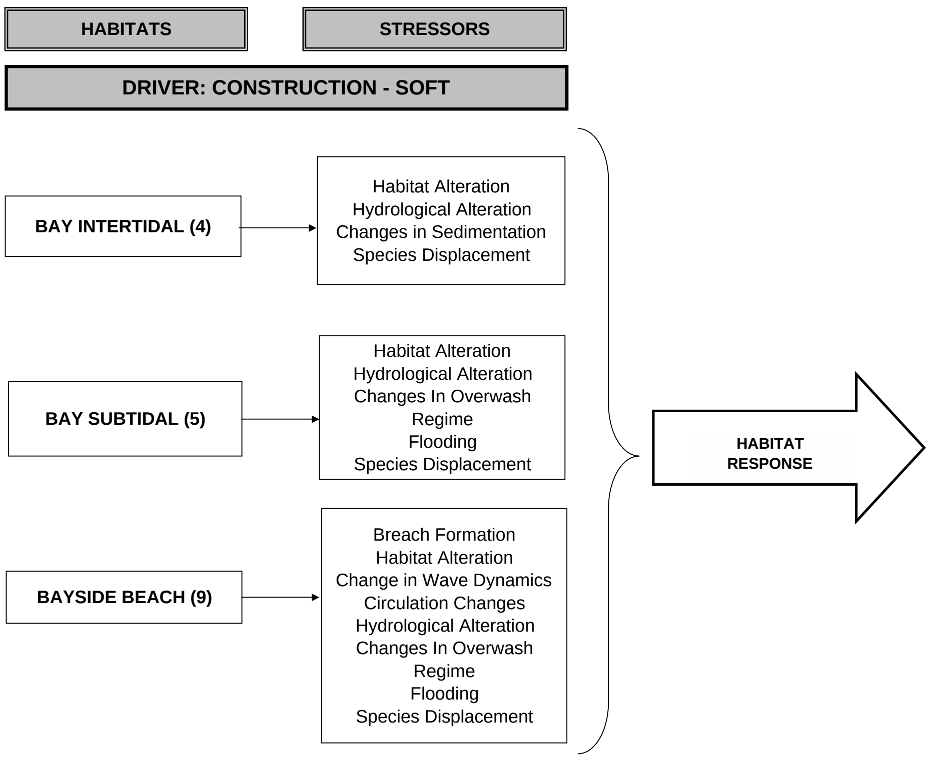
Salinity, frequency and extent of flooding of the marsh determine the types of plants and animals found there. The low marsh zone floods twice daily, while the high marsh floods only during storms and unusually high tides. Biota colonize these zones depending on how well they can withstand the drier conditions of the upper marsh or the wet conditions that regularly occur in the lower marsh.

Common in the project area, salt-meadow grass (*Spartina patens*) is characteristic of the high, irregularly flooded tidal marsh. These areas are flooded only by wind-driven or exceptionally high tides. Low marshes are flooded twice daily and are dominated by cordgrass (*Spartina alterniflora*), which may occur as only a narrow fringe seaward of the high marsh. Cordgrass is a primary source of organic matter to the estuary and is responsible for the growth of huge amounts of accompanying bacteria and algae that are ultimately flushed out of the marsh and transported to the bay waters.

Tidal marshes are among the most productive communities known. Much of the production is exported, mostly as *Spartina* wrack and detritus, to the adjacent estuary. Marshes are also important in stabilizing shorelines and a wildlife habitat.

Figure 14
Phase 3 Conceptual Model - Bayside Shoreline
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL -BAYSIDE SHORELINE



HABITATS / ENDPOINTS

HABITATS	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
CONSTRUCTION - SOFT													
Bay Intertidal	2	2	2	3	--	2	3	--	3	--	--	--	--
Bay Subtidal	1	2	2	3	--	--	3	--	--	--	--	--	--
Bayside Beach	--	1	--	--	--	--	3	--	3	--	3	--	--

Note: The driver for Bayside Shoreline is Construction - Soft.

Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

Barrier Island Processes. Tidal Marsh Restoration has the potential to affect Estuarine Processes by providing additional or enhanced habitat for forage, breeding and nursery areas for invertebrates and finfish and increased organic input to the barrier island system. Additionally, the increased biodiversity associated with Tidal Marshes significantly increases migratory and shorebird species (Table 4). Bayside Shoreline Process(es) will also be affected by Tidal Marsh Restoration. Tidal Marshes provide stability to shorelines, decreasing erosion rates and increasing the absorption of silts and organics as they run off of the upland into the bay. This function is especially important in non-point source pollution control of the mainland. Improvements in estuarine and Bayside Shoreline Processes combined result in both a rich, diverse community, as well as a healthier, more stabile shoreline environment.

Phase 3 Model-Tidal Marsh Restoration. Tidal Marsh Restoration is the intentional alteration of a site to establish the approximate biological, geological, and physical conditions that existed in the predisturbance indigenous Tidal Marsh habitat. Restoration can involve returning a nontidal area to tidal flushing, planting of high wildlife value vegetation, and modification of other aspects of the site. Modifications such as contouring or vegetation planting can increase the diversity of the habitat and hence, the ecological functions it can provide. Tidal Marsh Restoration is associated with Plantings and Invasive Species Control, Bayside Shoreline (Figure 14) and Island Restoration (Figures 7 and 15).

Figure 15 is the Phase 3 Model for Tidal Marsh Restoration. Construction-Soft is the driver associated with this restoration feature.

The following five bayside habitats could potentially be affected in the restoration of Tidal Marsh within the FIMP study area: Bay Intertidal, Bay Subtidal, Bayside Beach, Sand Shoals and Mud Flats and existing Tidal Marsh Habitats.

Most of the endpoints associated with Tidal Marsh Restoration are Aquatic endpoints since this habitat is located largely in the intertidal zone. Transitional Vegetation, Amphibians and Reptiles and Birds are also included in the model. Potentially affected Aquatic endpoints include Vegetation, Invertebrates, Finfish, and Birds.

Aquatic Birds, and Transitional Amphibians and Reptiles, and Birds were given the highest rank (3) owing to the potential presence of endangered and threatened species in these habitats. Tidal marsh vegetation is particularly important to terrapins; in fact, the total acreage of tidal marsh vegetation in large part determines the size of the terrapin population supported in a specific area (M. Draud, Personal Communication, 2006). Species and habitats are also protected by the NewYork State Tidal Wetlands Act; the potential presence of Essential Fish Habitat also results in a rank of (2) for Finfish endpoints. The Migratory Bird Treaty Act also affords protection to Birds. Subtidal Vegetation and Bayside Beach Invertebrates, along with Bay Intertidal and Salt Marsh Vegetation were ranked the lowest. While Salt Marsh Vegetation was given a rank of only 1 based on the defined ranking scheme (See Section 2.4.), its importance with respect to the habitat should not be understated. Furthermore, as discussed above, healthy Salt Marsh habitat also acts to stabilize the bayside shoreline.

5.1.13 SAV Restoration

Description. Eelgrass (*Zostera marina*) and, to a far lesser extent, widgeon grass (*Ruppia maritima*) are the two species of seagrasses that predominate and comprise the SAV beds in

Figure 15
Phase 3 Conceptual Model - Tidal Marsh Restoration
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - TIDAL MARSH RESTORATION

HABITATS → **STRESSORS**

DRIVER: CONSTRUCTION - SOFT

BAY INTERTIDAL (4) →
- Habitat Alteration
- Hydrological Alteration
- Changes in Sedimentation
- Species Displacement

BAY SUBTIDAL (3) →
- Habitat Alteration
- Hydrological Alteration
- Species Displacement

BAYSIDE BEACH (9) →
- Breach Formation
- Habitat Alteration
- Change in Wave Dynamics
- Circulation Changes
- Hydrological Alteration
- Changes In Overwash Regime
- Flooding
- Species Displacement

SAND SHOALS AND MUD FLATS (10) →
- Breach Formation
- Habitat Alteration
- Change in Wave Dynamics
- Change in Nutrient Concentrations
- Changes in Sedimentation
- Contaminants
- Hydrological Alteration
- Changes In Overwash Regime
- Flooding
- Species Displacemnet

TIDAL MARSH (4) →
- Habitat Alteration
- Hydrological Alteration
- Changes in Sedimentation
- Species Displacement

HABITAT RESPONSE →

HABITATS | **ENDPOINTS**

	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
CONSTRUCTION - SOFT													
Bay Intertidal	**2**	**2**	**2**	**3**	**--**	**1**	**3**	**--**	**3**	**--**	**--**	**--**	**--**
Bay Subtidal	**1**	**2**	**2**	**3**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Bayside Beach	**--**	**1**	**--**	**--**	**--**	**--**	**3**	**--**	**3**	**--**	**3**	**1**	**3**
Sand Shoals and Mud Flats	**--**	**2**	**2**	**3**	**--**	**--**	**3**	**--**	**3**	**--**	**--**	**--**	**--**
Tidal Marsh	**2**	**2**	**2**	**3**	**--**	**1**	**3**	**--**	**3**	**--**	**--**	**--**	**--**

Note: The driver for Tidal Marsh Restoration is Construction - Soft.

Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

FIMP study area. The distribution of the beds is dictated by physicochemical parameters. Eelgrass generally occupies the deeper, more saline waters of the bays and estuaries, while widgeon grass is characteristically found in the shallower, quiescent coves, sluggish tidal creeks, brackish pools, and often near sources of freshwater. Light penetration, salinity levels, temperature, waves, currents, sediment grain size, and sediment organic content all influence SAV distribution.

Areas of SAV occur in Subtidal Bay habitat where dense communities become established and provide forage and habitat for other aquatic biota. Any event that causes the bays to deepen greater than approximately 8', or reduce light penetration such as increased sedimentation, turbidity or nutrient flows, will negatively affect SAV distribution.

SAV is one of the most important features of the Bay Subtidal habitats since it provides nursery areas for finfish and a niche for colonization of epiphytic algae and invertebrates. SAV was not captured as a discrete habitat model, but was combined with Bay Subtidal habitats in the Phase 1 model development. It was later listed as a separate habitat with a separate model in Phase 2 owing to its ecological sensitivity and function and value as habitat.

Prior to this study, comprehensive surveys of SAV within the region of the FIMP study area are generally lacking. As part of the FIMP Reformulation Study, the USACE conducted a delineation of Submerged Aquatic Vegetation in Great South Bay, Moriches Bay and Shinnecock Bay (USACE 2002). Subsequently, in 2001 the USACE conducted a field reconnaissance effort to "ground-truth" a select number of previously mapped SAV beds. Three years of additional monitoring was conducted on the beds in 2003, 2004, and 2006. The reader is referred to the summary of available historic and physiological data relevant to SAV within the FIMP study area that was compiled by USACE (2002).

There is a clear correlation between water depths and distribution of SAV beds in Great South Bay. In general, SAV beds are not present in areas deeper than 2 m below Mean Sea Level (MSL). The three largest SAV beds in Great South Bay are located over the shallowest areas: South Oyster Bay, north of East and West Fire Islands, and along the southeastern shore of Great South Bay (from Watch Hill to Smith Point). This distribution pattern is related to light penetration and surface water turbidity.

SAV abundance also correlates strongly with bottom depth in Moriches Bay, with SAV extending to depths of approximately 2 m. While the data suggest that the average bottom elevation of SAV beds is deeper at Moriches (approximately 1.5 m) compared to Great South Bay (less than 1 m), this increase is likely related to increased tidal range, flushing, and water clarity (see discussion on hydraulic and water quality parameters below). Although also limited, SAV beds along the mainland shoreline appear to be more extensive than in Great South Bay, possibly due to reduced exposure to waves and improved water clarity.

SAV coverage appears to be less limited by water depth in Shinnecock Bay than in Moriches Bay or Great South Bay. Large beds are found along the northern edge of the inlet flood shoal, in depths ranging from 2 to 4 m. Coverage is also thick along the barrier island shoreline west of the inlet, in depths of up to 2.5 m. Nonetheless, an increase in SAV depth is reasonable given that tidal range, flushing, and water clarity are greater in Shinnecock than in Great South or even Moriches Bays.

Barrier Island Processes. Enhancement of existing SAV or creation of new SAV has the potential to affect Estuarine Processes in providing additional or enhanced habitat for forage, breeding and nursery areas for invertebrates and finfish. In addition, SAV provides support to the integrity of the Bayside Shoreline. Furthermore, healthy eelgrass beds increase estuarine health and can also improve overall health of the barrier island (Table 4).

The decomposition of senescent vegetation of the beds also contributes to detritus production. Invertebrates feeding on the organic matter provide food for higher trophic levels. Conversely, anything that affects sediment transport in the areas of SAV can also affect the SAV.

Finally, as stated above healthy eelgrass beds primarily serve to increase estuarine health but can have a secondary benefit to strengthen the bayside shoreline of the barrier island system. When SAV beds are found offshore of the bayside shoreline the actual land mass (the barrier island) is more stable and less susceptible to breaching and overwash impacts. In these events, as sediment moves over the barrier it becomes trapped in the SAV beds (similar to the effect in Tidal Marsh communities) and strengthens the barrier island system. Thus, SAV beds yield improvements in not only estuarine and biological health but aid in the physical stability of the barrier island itself.

Phase 3 Model-SAV Restoration. SAV Restoration is the process of seeding, plugging, or transplanting Sub-Aquatic Vegetation in order to restore SAV beds to a pre-disturbance condition. Figure 16 is the Phase 3 Model for SAV Restoration. Construction-Soft is the driver associated with this restoration feature.

The following three bayside habitats could potentially be affected in the restoration of SAV beds within the FIMP study area: Bay Intertidal, Bay Subtidal and existing SAV Habitats.

Most of the endpoints associated with SAV Restoration are Aquatic endpoints since this habitat is located in the subtidal bay. Transitional Vegetation is the only other endpoint that was included in the model. Potentially affected Aquatic endpoints include Vegetation, Invertebrates, Finfish, and Birds. Increase in the extent of SAV habitat would increase the amount of habitat available for colonization by benthic invertebrates and fish. In the case of existing SAV habitat, birds would also be affected.

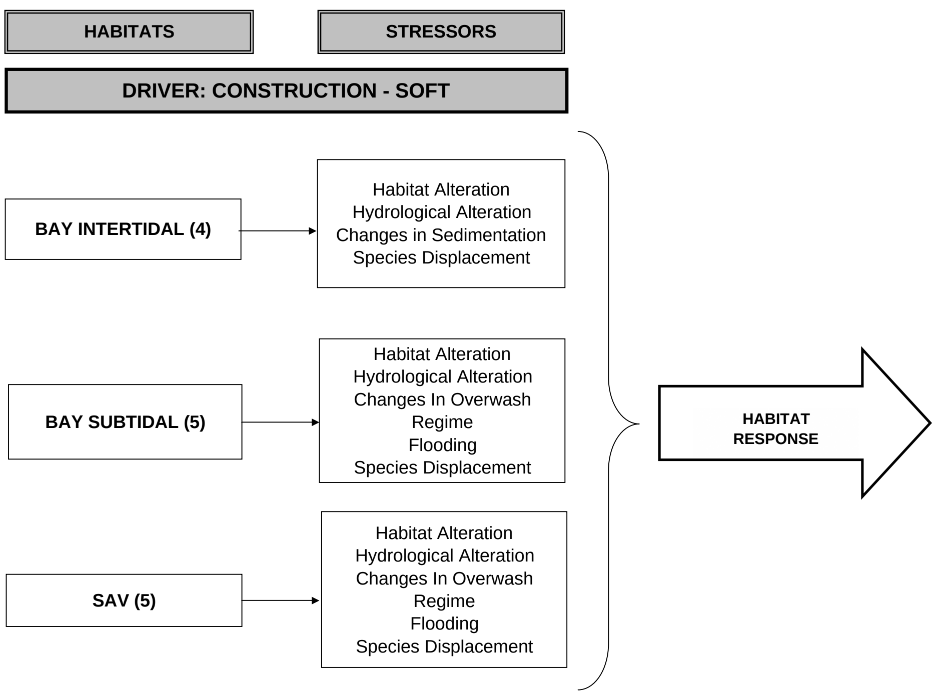
Most of the relevant endpoints were ranked of moderate importance (2) since there are no Endangered and Threatened Species of concern for this model. Although not specifically identified, species and habitats associated with SAV beds are protected by the New York State Tidal Wetlands Act and commercial and recreational fishing laws; the potential presence of Essential Fish Habitat also results in greater importance of Finfish endpoints. The Migratory Bird Treaty Act also affords protection to this endpoint.

5.1.14 Breach Contingency Plan

One of the long-term solutions being considered for storm damage reduction in the FIMP study area is to continue the existing Breach Contingency Plan (BCP)(USACE 1995) with some changes. This plan would continue to allow for the rapid closure of barrier island breaches by quickly mobilizing federal, state, and municipal resources. The BCP seeks to avoid response delays by negotiating closure designs, State/ Federal Project Cooperation Agreements, permits, and contracting procedures before the event occurs. Clear response timelines and responsibilities

Figure 16
Phase 3 Conceptual Model - SAV Restoration
Fire Island Inlet to Montauk Point

PHASE 3 CONCEPTUAL MODEL - SAV RESTORATION



HABITATS	ENDPOINTS												
	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
CONSTRUCTION - SOFT													
Bay Intertidal	2	2	2	--	--	2	--	--	--	--	--	--	--
Bay Subtidal	1	2	2	--	--	--	--	--	--	--	--	--	--
SAV	1	2	2	2	--	--	--	--	--	--	--	--	--

Note: The driver for SAV Restoration is Construction - Soft.

Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

are established to avoid repeating the delays associated with the closure of the December 1992 breach at Pikes Beach.

Although the BCP can be implemented at any location along the barrier islands fronting Great South Bay, Moriches Bay, and Shinnecock Bay, ten specific areas where breaching risk is higher were selected to serve as the basis for development of BCP plans. These selected areas are those where a breach or partial breach was observed in the baseline and future vulnerable conditions storm surge modeling simulations and include the following:

- Fire Island Lighthouse Tract
- Town Beach to Corneille Estates
- Talisman to Water Island
- Davis Park
- Old Inlet
- Smith Point County Park
- Sedge Island
- Tiana Beach
- West of Shinnecock

Three alternative breach closure plans are being developed, each providing different breach risk reduction levels, costs, and environmental impacts. An optimized fill plan will be later selected based on an economic analysis that will account for environmental impacts through a detailed HEP analysis. One of the three new BCP templates is similar to the current BCP template in that has maximum elevation roughly equal to the natural berm elevation (i.e., +9.5 ft NGVD). Two additional alternatives provide for increased level of protection against breaching by adding a small dune. These designs are based on the natural berm BCP design template with the addition of a small dune at +11 or +13 ft NGVD. The dune is centered on the baseline (i.e., existing dune alignment) and has a width of 25 ft. Ocean and bay side slopes are defined as 1 on 5. Potential BCP alternatives are currently under analysis. The reader can reference USACE documents for additional information on former breaches such as the Westhampton Breach.

The possibility of incorporating a wetland feature on the bay side of the breach closure plan depends on the specific location and dimensions of the open breach, which are unknown at this time. Locations with potential for incorporating wetlands are Smith Point County Park, and Tiana Beach.

The Phase 1 model development comprehensively identified all ecosystems, habitats, drivers, stressors and endpoints that could have any relevance to the FIMP study area and storm damage reduction project (USACE 2001). The Phase 2 document refined and focused the Phase 1 work using a systematic review of all ecosystems, habitats, drivers, stressors and endpoints (USACE 2004). The goal of Phase 2 model development was to refine a tool that could be more readily applied to the indigenous habitats and management and restoration features being considered for the study area; as such, conceptual models for 14 habitats within four ecosystems of the FIMP study area were developed. The 14 conceptual models are used to delineate and assess complete linkages or pathways between important drivers, stressors and endpoints that should be further investigated as part of the EIS for the storm damage reduction project.

This document has identified idealized transects which are intended to characterize different land use categories and represent the range of habitats that occurs within the FIMP project area. Phase 3 Models were developed to define potential impacts that occur as a result of project implementation. The range of positive and negative impacts that could occur to an area as a result of project implementation in a specific area is delineated based on application of the Phase 3 Models.

In this section assessment models for a hypothetical project that includes multiple features that will be applied to a representative transect identified in Section 3.0. All project and restoration features will be linked to a storm damage reduction feature and restore some aspect of one of the five processes identified in the Restoration Framework (Section 4.2). In addition, a hypothetical restoration feature will also be modeled. The following two hypothetical assessment models were developed for illustration purposes and are discussed in this section:

- Beach Nourishment/Renourishment project coupled with Dune Development is to be constructed in the Ocean Beach Transect
- Tidal Marsh Restoration will be performed on the WOSI Transect.

6.1 APPROACH

The development of the assessment model includes the following three steps:

- Selection of appropriate project and (where appropriate) restoration model(s);
- Incorporation of site-specific habitats; and
- Identification of relevant site-specific complete pathways.

Project Model Selection. Selection of the appropriate model is essential to the accurate impact analysis for any given project. The most representative model will ensure that the appropriate endpoints are assessed, and that relevant drivers and stressors have also been considered. All models (Figure 4 through 16) are carefully considered to identify the model that most closely represents the action to be performed. For example, in the case of dredging associated with Inlet Sand Bypassing, the dredging component must be that represented in the model for Bypass Sand Removal (Figure 10) and not Dredging (Figure 8). The Inlet Sand Bypassing model includes endpoints in the Sand Shoals and Mud Flats habitat, while the Dredging model includes endpoints in the Marine Offshore areas.

Habitat Selection. Similar to project model selection described above, selection of relevant habitats is essential to perform accurate impact analysis in the EIS. Each habitat has associated endpoints identified that must be considered. The cover type map is consulted for the project area. Each habitat within the project area that is also included in the project model, is incorporated into the assessment model.

Pathway Analysis. The compilation of project/restoration specific models along with data collected from the cover type map and the relevant habitat models results in the development of a site and project specific model that describes the range of potentially complete pathways that could be impacted by construction of the project. A complete pathway must include the following four elements to be carried into the EIS: a driver, stressor, contact mechanism and endpoint. The contact mechanism puts the stressor in contact with the endpoint resulting in an effect. For example, if sand were to be placed in an area where Sea Beach Amaranth occurs, the contact mechanism would be the proximity of the vegetation to the project site; if the amaranth is present an impact will occur, if there are no amaranth, there is no contact, the pathway is incomplete and there is no impact. Any complete pathway will be addressed in the EIS for the FIMP study, along with an assessment of the magnitude and extent of the potential impact(s). Once the assessment model is developed, the assessment of potential impacts attributable to the project feature can be performed as part of the EIS.

Each potentially complete pathway is carefully considered regarding its relevance to the specific project. For example, Marine Mammal endpoints are included in the list for the Intertidal habitat. If the Marine Intertidal habitat does not include a rocky shore, Marine Mammals would not be included, since this is the habitat they require.

In this section corresponding Phase 3 Models will be selected for both project and restoration features. Actual transects identified in Section 3 will be considered the location where the hypothetical project will be constructed. As with the development process for the Phase 3 Models, potentially impacted habitats will be included in the models; relevant drivers for each of the habitats will be identified, along with corresponding stressors. Endpoints that might be potentially impacted by the project or restoration features will be selected from Table 2.

6.2 BEACH NOURISHMENT/RENOURISHMENT; DUNE MODIFICATION-OCEAN BEACH TRANSECT

For the purposes of illustration, the first hypothetical 'project' will only include two features, Beach Nourishment/Renourishment and Dune Modification. Although this hypothetical project could involve dredging sand from offshore sources, this assessment assumes the source of sand is from adjacent dunes. The final model developed for the Beach Nourishment/Renourishment hypothetical project is presented in Figure 17. The development of the project-specific assessment model is described in the following paragraphs.

Model Selection. As discussed above, selection of the appropriate model or models is essential to the accurate impact analysis for any given project. In the selection of project models that will comprehensively incorporate all components necessary for the assessment, all 13 project and restoration models were carefully considered. Since the hypothetical project includes beach nourishment, any of the models that could include this component were considered. Figure 6, the model describing Beach Nourishment/Renourishment was determined to be the most

Figure 17
Assessment Model- Beach Nourishment/Renourishment and Dune Modification; Ocean Beach Transect
Fire Island Inlet to Montauk Point

ASSESSMENT MODEL- BEACH NOURISHMENT/RENOURISHMENT and DUNE MODIFICATION; OCEAN BEACH TRANSECT

HABITATS OF OCEAN BEACH TRANSECT	STRESSORS
MARINE OFFSHORE	None
MARINE NEARSHORE (5)	Habitat Alteration Hydrological Alteration Changes in Wave Dynamics Species Displacement **Human Stressors**
MARINE INTERTIDAL[2] (10)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors**
MARINE BEACH[2] (4)	Habitat Alteration Changes in Sedimentation Species Displacement **Human Stressors**
DUNES & SWALES[2] (10)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors**
DISTURBED[3]	Habitat Alteration Changes in Overwash Regime Flooding **Human Stressors**
SUBTIDAL BAY[3] (5)	Habitat Alteration Hydrological Alteration Changes in Overwash Regime Flooding Species Displacement
SAV[3] (5)	Habitat Alteration Hydrological Alteration Changes in Overwash Regime Flooding Species Displacement

HABITAT RESPONSE

HABITATS	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
Marine Offshore	1	--	--	--	--	--	--	--	--	--	--	--	--
Marine Nearshore	1	3	3	3	--	--	--	--	3	--	--	--	--
Marine Intertidal[2]	1[1]	1[2]	3	3	2[1]	--	--	2[1]	3[2]	--	--	--	--
Marine Beach[2]	--	--	--	--	--	3[2]	--	--	3[2]	--	--	--	--
Dunes & Swales[2]	--	--	--	--	--	3[2]	2[2]	--	3[2]	1[2]	--	--	--
Disturbed	--	--	--	--	--	3	2	--	3	--	--	--	--
Subtidal Bay	--	--	--	--	--	--	--	--	--	--	--	--	--
SAV	--	--	--	--	--	--	--	--	--	--	--	--	--

Note: The driver for Beach Nourishment/Renourishment and Dune Modification is Construction - Soft.
Words that appear underlined and bold in the 'Stressor' column represent stressor categories, and indicate that all stressors in that category are relevant to the specific driver.
Non-bolded/underlined words represent individual stressors that are also relevant to the indicated driver.
[1] Vegetation and Marine Mammals endpoints for the Intertidal Habitat refer to Rocky Intertidal only.
Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.
[2] Included in both Beach Nourishment/ Renourishment and Dune Development Mode
[3] Habitats relevant to Dune Development component only.

appropriate model for this component of the hypothetical project since it includes all drivers and stressors relevant to this activity.

Since the project is multifunctional, an additional model must be identified to address the Dune Modification aspect. The assessment model formed by the combination of these two conceptual models will represent the assessment structure for the hypothetical project. Figure 7, the model describing Dune Modification was determined to be the most appropriate model for this component of the hypothetical project.

The development of the final project-specific model is based on the combination of the Beach Nourishment/Renourishment and Dune Modification models. Any components that are relevant to both features are only included once in the assessment model. For example, the Marine Beach habitat is impacted by sand placement in the beach nourishment component of the the hypothetical project. Marine Beach is also potentially impacted in the Dune Modification portion, since the toe of the dune with border and grade into the beach. Nonetheless, Marine Beach only appears once in the model and is assessed only once.

Habitat Selection. Selection of all relevant habitats that could be affected by project construction for inclusion in the model is essential to perform a comprehensive impact analysis in the EIS. The first step in the identification of relevant habitats is consultation with the original project feature models to list all habitats included in the original two models (ie., Beach Nourishment/Renourishment and Dune Modification) that make up the assessment model. Next, the cover type map for the Ocean Beach Transect (Appendix B) is consulted along with Table 3, to confirm which habitats are relevant to this transect. While all habitats present in the component models are included in the assessment model for completeness, only the habitats found to be common to both the Beach Nourishment/Renourishment and the Dune Modification models, and actually occur on the Ocean Beach Transect are considered to be on complete impact pathways in the project specific model, and hence are assessed in the EIS. As discussed above, a habitat is only included in the final assessment once, even if it is included in both component models. The following eight habitats are included in the Beach Nourishment/Renourishment and/or the Dune Modification model, and also occur on the Ocean Beach Transect and are therefore, included in the assessment model for this hypothetical project:

- Marine Offshore
- Marine Nearshore
- Marine Intertidal
- Marine Beach
- Dunes and Swales
- Disturbed
- Subtidal Bay
- SAV

The complete set of endpoints that are relevant to the relevant habitats are included in the assessment model.

Pathway Analysis. Figure 17 is the assessment model for this hypothetical project and lists all components that will be considered in the impact analysis. Construction-Soft is the driver associated with both Beach Nourishment/Renourishment and Dune Modification since neither one involves engineered structures. Potential impacts associated with the Beach Nourishment/Renourishment and Dune Modification models are detailed in Sections 5.1.2 and 5.1.3, respectively, and discussed with respect to this hypothetical project below.

All three categories of endpoints could be impacted by both Beach Nourishment/Renourishment and Dune Modification. Aquatic Invertebrates, Finfish and Birds are ranked highest owing to the presence of endangered and threatened species and/or Essential Fish Habitat in the Marine Nearshore and Marine Intertidal habitats. Transitional Vegetation and Birds were also given the highest importance for the same reason. Terrestrial Vegetation is the only endpoint of concern in this category and is ranked low. There are no endpoints of concern for the Marine Nearshore, Subtidal Bay or SAV habitats. Since no endpoints in the Marine Offshore, Subtidal Bay and SAV habitats would be affected by this hypothetical project (they don't occur on the transect), these pathways are included in the model for completeness since they occur in the Ocean Beach Transect, but would not be assessed in the EIS. In general, there are three trends readily noted from the project assessment model:

- Negative impacts are short-term associated with Beach Nourishment/Renourishment
- Positive impacts are long-term and associated with Dune Modification;
- There would be short-term negative impacts to endpoints of the Marine Nearshore and Intertidal habitats due to sand placement;
- Both short-term negative, and long-term positive impacts would occur to Transitional endpoints; and
- The project would afford long-term positive impacts to several Transitional endpoints of the disturbed habitat or cover type.

Barrier Island Processes. All project features and restoration features must incorporate barrier island processes. Barrier island processes of Longshore Transport, Cross Island Transport and Dune Development would be affected by this project. The greatest potential affects will be positive impacts on the beach and dune areas, but adjacent intertidal and subtidal zones can also be impacted.

6.3 TIDAL MARSH RESTORATION - WOSI TRANSECT

The second hypothetical 'project' is Tidal Marsh Restoration on the WOSI Transect. The final assessment model developed for this hypothetical Tidal Marsh Restoration project is presented in Figure 18. The development of the project-specific assessment model is described in the following paragraphs.

Model Selection. Components of Tidal Marsh Restoration were included in several project models. Hence, any of the models that could include this component were considered. Figure 15, the model describing Tidal Marsh Restoration was determined to be the most appropriate model for this component of the hypothetical project since it includes all drivers and stressors relevant to this activity.

Since this project includes only one component, the development of the final project-specific model is based solely on the components included in the Tidal Marsh Restoration model.

Habitat Selection. Selection of all relevant habitats that could be affected by project construction for inclusion in the model is essential to perform a comprehensive impact analysis in the EIS. The first step in the identification of relevant habitats for the assessment model is consultation with the original project feature model (ie., Figure 15 Tidal Marsh Restoration). Next, the cover type map for the WOSI Transect (Appendix B) is consulted along with Table 3, to confirm which habitats are relevant to this transect. As discussed above, while all habitats present in the conceptual model are included in the assessment model for completeness, only the habitats found to be common to both the Tidal Marsh Restoration model, and actually occur on the WOSI Transect are considered to be on complete impact pathways in the project-specific model, and hence are assessed in the EIS. The following 11 habitats are included in the Tidal Marsh Restoration model for WOSI:

- Marine Offshore
- Marine Nearshore
- Marine Intertidal
- Marine Beach
- Dunes and Swales
- Upland Terrestrial
- Disturbed
- Intertidal Bay
- Sand Shoal/Mudflat
- SAV
- Subtidal Bay

The complete set of endpoints that are relevant to the included habitats are part of the assessment model.

Pathway Analysis. Figure 18 is the assessment model for the hypothetical WOSI restoration. Construction-Soft is the driver associated with Tidal Marsh Restoration. Potential impacts associated with Tidal Marsh Restoration are detailed in Section 5.1.12 and discussed with respect to this hypothetical restoration project below. While a total of 11 habitats occur on the WOSI Transect, only those found to be relevant in Phase 3 Model development of the Tidal Marsh Restoration model are included in the assessment; the habitats common to the WOSI Transect and the model are the Bay Intertidal, Sand Shoals and Mud Flats and Tidal Marsh. Hence, only these three habitats could be potentially impacted by the hypothetical restoration. While no endpoints in the other eight habitats would be affected by this hypothetical restoration, they are included in the assessment model for completeness since they occur in the WOSI Transect.

Aquatic and Transitional endpoint categories could be impacted by Tidal Marsh Restoration along the WOSI Transect. Endpoints given the highest importance were based on the potential presence of Endangered and Threatened species.

Figure 18
Assessment Model - Tidal Marsh Restoration; WOSI Transect
Fire Island Inlet to Montauk Point

ASSESSMENT MODEL - TIDAL MARSH RESTORATION; WOSI TRANSECT

DRIVER: CONSTRUCTION - SOFT

HABITATS OF WOSI TRANSECT	STRESSORS
MARINE OFFSHORE (0)	None
MARINE NEARSHORE (5)	Habitat Alteration Hydrological Alteration Changes in Wave Dynamics Species Displacement **Human Stressors**
MARINE INTERTIDAL (10)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors**
MARINE BEACH (4)	Habitat Alteration Changes in Sedimentation Species Displacement **Human Stressors**
DUNES AND SWALES (10)	**Physical Stressors** **Hydrological Stressors** Changes in Sedimentation Species Displacement **Human Stressors**
TERRESTRIAL UPLAND (7)	**Physical Stressors** Changes in Overwash Regime Flooding Hydrological Alteration Species Displacement **Human Stressors**
DISTURBED	None
BAY INTERTIDAL (4)	Habitat Alteration Hydrological Alteration Changes in Sedimentation Species Displacement
BAY SUBTIDAL (3)	None
BAYSIDE BEACH (9)	None
SAND SHOALS AND MUD FLATS (10)	Breach Formation Habitat Alteration Change in Wave Dynamics Change in Nutrient Concentrations Changes in Sedimentation Contaminants Hydrological Alteration Changes In Overwash Regime Flooding Species Displacemnet
TIDAL MARSH (4)	Habitat Alteration Hydrological Alteration Changes in Sedimentation Species Displacement
SAV (5)	Habitat Alteration Hydrological Alteration Changes in Overwash Regime Flooding Species Displacement

HABITAT RESPONSE

HABITATS	Aquatic					Transitional				Terrestrial			
	Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
CONSTRUCTION - SOFT													
Marine Offshore	1	--	--	--	--	--	--	--	--	--	--	--	--
Marine Nearshore	1	--	--	--	--	--	--	--	--	--	--	--	--
Marine Intertidal	--	--	--	--	--	--	--	--	--	--	--	--	--
Marine Beach	--	--	--	--	--	--	--	--	--	--	--	--	--
Dunes and Swales	--	--	--	--	--	--	--	--	--	--	--	--	--
Marine Beach	--	--	--	--	--	--	--	--	--	--	--	--	--
Upland Terrestrial	--	--	--	--	--	--	--	--	--	--	--	--	--
Disturbed	--	--	--	--	--	--	--	--	--	--	--	--	--
Bay Intertidal	2	2	2	3	--	1	3	--	3	--	--	--	--
Bay Subtidal	--	--	--	--	--	--	--	--	--	--	--	--	--
Bayside Beach	--	--	--	--	--	--	--	--	--	--	--	--	--
Sand Shoals and Mud Flats	--	2	2	3	--	--	3	--	3	--	--	--	--
Salt Marsh	2	2	2	3	--	1	3	--	3	--	--	--	--
SAV	--	--	--	--	--	--	--	--	--	--	--	--	--

Note: The driver for Tidal Marsh Resoration is Construction - Soft.

Endpoint Ranking: 1-3, lowest to highest as follows, (1)presence of endpoint in habitat, no special status or protection; (2) commercial or recreational importance, and/or existance of environmental regulations relevant to protection of the habitat or its biota, and (3)endangered and threatened species status.

In general, there are two trends readily noted from the project assessment model:

- Potential impacts are localized and in the immediate vicinity of the Tidal Marsh
- The restoration project would afford long-term positive impacts to Aquatic and Transitional endpoints of Bay Intertidal, Sand Shoals and Mud Flats, and Tidal Marsh habitats.

Barrier Island Processes. Barrier island processes of Cross Island Transport, Bayshore Processes and Estuarine Processes would be affected by this restoration project albeit on a local scale. Increased coverage of Tidal Marsh affects to trap sediments distributed in Cross Island Transport. Bayshore Processes in the vicinity of WOSI would improve including the increased diversity in habitat, and improved circulation and sedimentation. Similarly, Estuarine Processes of circulation would also be enhanced on a local scale.

6.4 CONCLUSION

The overall objective of the Phase 3 Model development is to provide a framework to systematically identify complete pathways or linkages that must be explored in the EIS. In this way, a systematic and comprehensive assessment of multidimensional features can be performed, and the EIS will be an environmentally sound and technically defensible document that incorporates the interests of all stakeholders and addresses all potential positive and negative impacts of the FIMP storm damage reduction project for the 83-mile study area. The Phase 2 habitat models, in combination with the Phase 3 project feature models, are sufficiently comprehensive and flexible to provide a framework for reliable assessment of any proposed project alternative in the study area.

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Table 1
Habitat Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

ECOSYSTEM/HABITAT	DEFINITION
Coastal Marine Ecosystem	
Marine Offshore	Subtidal marine habitat ranging in depth from 10 to 30 meters; includes pelagic and benthic zones
Marine Nearshore	MLW to depth of 10 meters; includes pelagic and benthic components
Marine Intertidal	Extends from the boundary of the Marine Nearshore at MLW to MHW with a sandy and/or rocky substrate
Ocean Beach and Dune Ecosystem	
Marine Beach	Extends from the MHW line on the ocean side to the boundary of the primary Dune and Swale habitat with the Terrestrial Upland; sandy substrate
Dunes and Swales	Primary dune through most landward primary swale system;
Bay Ecosystem	
Bay Intertidal	Extends from the Terrestrial Upland boundary with MHW, or landward limit of high marsh vegetation of the barrier island Terrestrial Upland habitat, to MLW. May include other habitats such as Salt Marsh, Shoals, and/or Mud Flat.
Sand Shoals, Bare Sand, Mud Flats	Found within the Intertidal zone and exposed at low tide; specific habitat type is defined by the substrate type
Tidal Marsh	Bayside vegetation communities dominated and defined by salt-tolerant species; occurs from the landward limit of the high marsh vegetation, sometimes also MHW or slightly landward to the seaward limit of the intertidal marsh vegetation
Bay Subtidal	Bayside aquatic areas below the MLW
SAV	Bayside vegetation communities found within the subtidal zone
Inlets	Areas of water interchange between backbay and ocean zones (e.g., Fire Island Inlet, Moriches Inlet, and Shinnecock Inlet)
Barrier Island Upland Ecosystem	
Terrestrial Upland	Extends from the landward boundary of the primary dunes and swales on the ocean side, to the MHW boundary of the Bay Intertidal habitat on the bay side of the island contains all upland habitats excluding the maritime forest; scrub/shrub are also included in this habitat, along with bayside beach areas
Maritime Forest	Forested area on barrier island defined by salt tolerant vegetation, high salinity and salt spray adapted soils and vegetation assemblages such as trees, shrubs, and herbaceous species (i.e. Sunken Forest)
Bayside Beach	Area between MHW to seaward limit of vegetation or “upland” boundary

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	COASTAL MARINE ECOSYSTEM ENDPOINTS						
	Vegetation	**Marine Invertebrates**	**Amphibians & Reptiles**	**Finfish**	**Birds**	**Marine Mammals**	**Terrestrial Mammals & Insects**
Marine Offshore	Phytoplankton	**Benthic:** Polychaetes, Amphipods, Sand Dollar, Sea Star, *Yoldia* sp., Horseshoe Crabs **Epibenthic:** Shrimp **Pelagic:** Jellyfish, Phytoplankton, Zooplankton **Commercial & Recreational:** Clams, Lobster, Squid, Surf Clam, Scallop, Ocean Quahog, Crabs	**Sea Turtles:** Kemps-Ridley[(1)], Hawksbill, Loggerhead, Green, Leatherback	Skates **Commerical & Recreational:** **Pelagic:** Hake, Scup, Bluefish, Butterfish, Striped Bass, Herring, Mackerel **Benthic:** Sandlance, Winter, Summer and Windowpane Flounders, Monkfish		**Mammals:** Atlantic Right & Pygmy-Sperm Whales	
Marine Nearshore	Phytoplankton	**Benthic:** Polychaetes, Amphipods, Sea Stars, *Yoldia* sp. **Epibenthic:** Shrimp **Pelagic:** Jellyfish, Phytoplankton, Zooplankton **Commercial & Recreational:** Clams, Lobster, Squid, Surf Clam, Ocean Quahog	**Sea Turtles:** Kemps-Ridley Hawksbill, Loggerhead	**Commercial & Recreational:** **Benthic:** Winter and Summer Flounders **Pelagic:** Silversides, Anchovies, Bluefish, Striped Bass, Mackerel, Herring	**Piscivorous:** Cormorant, Osprey, Common & Least Terns, Roseate Terns, Mergansers, **Other:** Loons **Commercial & Recreational:** Sea Ducks	**Seals:** Harbor, Gray	

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	COASTAL MARINE ECOSYSTEM ENDPOINTS						
	Vegetation	Marine Invertebrates	Amphibians & Reptiles	Finfish	Birds	Marine Mammals	Terrestrial Mammals & Insects
Marine Intertidal	Macro-algae(2)	**Benthic:** Polychaete (*Scolelepis*), Amphipods, Isopods, Bivalve (*Donax*), Mole Crab **Attached/Sessile Forms(2):** Barnacles, Limpets, Mussels, Chitons, Hermit Crabs, Snails		Silversides, Kingfish, Bluefish, Anchovy	**Shorebirds:** Sandpipers, Piping Plover, Gulls **SeaBirds:** Osprey, Common & Least Terns	**Seals(2):** Harbor, Gray	

HABITAT	OCEAN BEACH AND DUNE ECOSYSTEM ENDPOINTS						
	Vegetation	Marine Invertebrates	Amphibians & Reptiles	Finfish	Birds	Marine Mammals	Terrestrial Mammals & Insects
Marine Beach	Sea Beach Amaranth, Annuals, Sea Beach Knotweed				Least & Common Terns, Piping Plover, Shorebirds, Snowy Owls		**Mammals:** Red Fox **Insects:** Northeast Tiger Beetle
Dunes & Swales	Beach Grass, Shrubs, Panic Grass, *Salicornia*, Sea Beach Amaranth, Herbaceous Perennials		Frogs, Diamondback Terrapin		Piping Plover, Residents (Horned Lark, Snow Bunting), Owls (Snowy, Short-eared)		**Mammals:** Deer, Red Fox, Raccoon **Insects:** Ticks, Northeast Tiger Beetle

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	BAY ECOSYSTEM ENDPOINTS						
	Vegetation	**Marine Invertebrates**	**Amphibians & Reptiles**	**Finfish**	**Birds**	**Marine Mammals**	**Terrestrial Mammals & Insects**
Bay Intertidal	Macroalgae, Intertidal & High Marsh Species, *Phragmites*	Horseshoe Crab, Barnacle, Eastern Mudsnail, Say Mud Crab, Hermit Crabs, Green Crab, Other Crabs Amphipods, Isopods, Sea Star, Phytoplankton, Zooplankton **Commercial & Recreational:** Blue & Ribbed Mussels, Blue Crab, Softshell Clam	Diamondback Terrapin	**Forage/Bait:** Silversides, Killifish, Cunner **Commercial & Recreational:** Tautog, Weakfish, Bluefish, Black Sea Bass, Striped Bass, Herrings, Blackfish	Piping Plover, Least Tern, Shorebirds, Wading & Migratory spp., Cormorant, Gulls, Sparrow (Sharp-tail and Sea-side), Oystercatcher	Harbor Seal	Mosquitoes
Bay Subtidal	**Macroalgae:** *Cladophora*, *Ulva*, **SAV:** Eelgrass, Widgeon Grass **Phytoplankton** (brown tide)	Say Mud Crab, Green Crab, Other Crabs, Comb Jelly, Sea Star, Polychaetes, Jellyfish, Shrimp, Phytoplankton, Zooplankton **Commercial & Recreational:** Hard Clam, Blue Crab, Scallop	Diamondback Terrapin	**Forage/Bait:** Cunner, Killifish, Silversides, Northern Puffer, Pipefish Sticklebacks **Commercial & Recreational:** Winter Flounder, American Eel, Blackfish	Gulls, Common & Least Terns, Cormorant, Loons, Black Skimmer **Commercial & Recreational:** Black Duck		

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	BAY ECOSYSTEM ENDPOINTS						
	Vegetation	**Marine Invertebrates**	**Amphibians & Reptiles**	**Finfish**	**Birds**	**Marine Mammals**	**Terrestrial Mammals & Insects**
Sand Shoals, Bare Sand & Mud Flats	Cyanobacteria	Horseshoe Crab, Fiddler Crabs **Commercial & Recreational:** Blue Mussel, Ribbed Mussel, Softshell Clam	Diamondback Terrapin	**Forage/Bait:** Killifish, Killifish; Juvenile Fish **Commercial & Recreational**: Winter and Summer Flounder, Blue Fish	Shorebirds, Egrets, Herons, Seabirds, Oystercatcher, Migratory & Resident Species, Piping Plover, Least & Common Terns		
Tidal Marshes	Intertidal & High Marsh Species, *Salicornia, Phragmites*	Horseshoe Crab, Barnacle, Eastern Mudsnail, Say Mud Crab, Blue Crab, Hermit Crabs, Other Crabs Amphipods, Isopods **Commercial & Recreational:** Blue & Ribbed Mussels	Diamondback Terrapin	**Forage/Bait:** Silversides, Killifish, Cunner **Commercial & Recreational:** Tautog, Weakfish, Bluefish, Black Sea Bass, Striped Bass, Herrings	Osprey, Egrets, Herons, Sparrow (Sharp-Tail and Sea-side), Oystercatcher, Rails		

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	BAY ECOSYSTEM ENDPOINTS						
	Vegetation	**Marine Invertebrates**	**Amphibians & Reptiles**	**Finfish**	**Birds**	**Marine Mammals**	**Terrestrial Mammals & Insects**
SAV	Macroalgae **SAV:** Eelgrass, Widgeon Grass	Horseshoe Crab, Barnacle, Eastern Mudsnail, Say Mud Crab, Hermit Crabs, Green Crab, Other Crabs Amphipods, Isopods, Softshell Clam, Hard Clam, Sea Star, Comb Jelly, Scallop, Polychaetes, Jellyfish, Shrimp **Commercial & Recreational:** Blue & Ribbed Mussels, Blue Crab	Sea Turtles	**Forage/Bait:** Cunner, Killifish, Silversides, Northern Puffer, Pipefish Sticklebacks **Commercial & Recreational:** Tautog, Weakfish, Bluefish, Black Sea Bass, Striped Bass, Herrings, Winter Flounder, American Eel, Blackfish	**Commercial & Recreational:** Brant, Black Duck Great Blue Heron		

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	BAY ECOSYSTEM ENDPOINTS						
	Vegetation	**Marine Invertebrates**	**Amphibians & Reptiles**	**Finfish**	**Birds**	**Marine Mammals**	**Terrestrial Mammals & Insects**
Inlets		**Benthic:** Polychaetes, Horseshoe Crab, Amphipods, Sea Star, *Yoldia*, Eastern Mudsnail, Say Mud Crab, Hermit Crabs, Green Crab, Other Crabs, Isopods, Phytoplankton, Zooplankton **Epibenthic:** Shrimp, Barnacle **Pelagic:** Jellyfish **Commercial & Recreational:** Clams (Ocean Quahog), Lobster, Squid, Blue Crab, Blue & Ribbed Mussels, Surf Clam, Softshell Clam	**Sea Turtles:** Kemps-Ridley, Loggerhead, Hawksbill, Diamondback Terrapin	**Pelagic:** Hake, Skates **Benthic:** Sandlance, Windowpane **Forage/Bait:** Silversides, Killifish, Cunner, Anchovies Northern Puffer, Pipefish Sticklebacks **Commercial & Recreational:** Winter & Summer Flounders, Scup, Tautog, Butterfish, Bluefish, Herrings, Striped Bass, Weakfish, Black Sea Bass, American Eel	**Seabirds:** (Cormorant) Loons, Grebes **Commercial & Recreational:** Ducks (Scaup, Black)	**Seals:** Harbor Gray	

Table 2
Ecological Endpoint Summary
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

HABITAT	BARRIER ISLAND UPLAND ECOSYSTEM ENDPOINTS						
	Vegetation	**Marine Invertebrates**	**Amphibians & Reptiles**	**Finfish**	**Birds**	**Marine Mammals**	**Terrestrial Mammals & Insects**
Terrestrial Upland (including Bayside Beach)	Short, Prostrate Pine species, Pitch Pines, Red Maple Swamp Forest, Maritime Scrub, Maritime Oak/Holly Forest, Disturbed “vegetated” land (non-indigenous species), Pine Barren Community	Benthic Invertebrates, Wrack Invertebrates (Amphipods, Isopods)	Frogs, Diamondback Terrapin, Turtles (Mud, Box, Spotted)		**Raptors:** Owls, Hawks, Osprey Migratory Neotropical Species, Resident & Migratory Passerine Species Piping Plover, Least & Common Terns		**Mammals:** Deer, Red Fox, Raccoon, White-footed Mouse, Voles, Moles **Insects:** Bees, Mosquitoes, Ticks, Greenhead Fly, Wrack Insects
Maritime Forest	Sunken Forest Species (Trees, Shrubs, Herbaceous Perennials), Cherries Vines		Salamander (Tiger), Turtles (Mud, Box, Spotted), Eastern Hognose Snake		Warbler, Migratory Species		**Mammals:** Deer **Insects:** Ticks, Mosquitoes
Coastal Ponds (e.g. Georgica Pond) (3)	SAV, Emerged Species, *Phragmites*, Purple Loosestrife, Intertidal and High Marsh Species	**Commercial & Recreational:** Oysters	Diamondback Terrapin	Migratory & Resident Species (e.g., Trout), Anadromous Species (Eels)	Least & Common Terns, Osprey, Shorebirds		
Freshwater Wetlands(3)	Bogs & Vines, Sedges, Rushes, Grasses, Cattail, *Phragmites*		Salamanders (Tiger), Toads, Turtles, Frogs	**Commercial & Recreational:** Anadromous (Salmonids, Herrings, Eels) Stocked Trout (Rainbow, Brook)	**Waterfowl:** Canada Goose, Waders, Rails **Commercial & Recreational:** Ducks		Mosquito

Notes: (1)Federal and/or State Endangered and Threatened species are underlined throughout the table; Diamondback Terrapin is not an Endangered and Threatened species, but underlined due to its local importance. Similarly, the Northeast Tiger Beetle is extirpated but has been retained on the list of Endangered and Threatened Species for the purposes of the Conceptual Model due to its potential local importance. The Osprey is another example of a species of special concern. (2) Indicates endpoint relevant only to Rocky Intertidal Habitat. (3) Coastal Ponds, and Freshwater Wetlands endpoints are listed here as part of the Barrier Island Upland Ecosystem, but no models for these habitats have been presented; they are described in Phase 3 text.

TABLE 3
SUMMARY OF TRANSECT CHARACTERISTICS
PHASE 3 CONCEPTUAL SITE MODEL
FIRE ISLAND INLET TO MONTAUK POINT STUDY AREA

TRANSECT	REACH LOCATION	ECOSYSTEMS/HABITATS	Aquatic					Transitional				Terrestrial			
			V	I	F	B	M	V	AR	M	B	V	B	MI	AR
1- DEMOCRAT POINT	**Great South Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	E	E	-	E	E	E	-	-	-	-
		2. **Ocean Beach & Dune:** Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	-
		3. **Upland Ecosystem:** Mixed Vegetation/*Phragmites*, Terrestrial Upland, Disturbed										P	E	P	E
		4. **Bay Ecosystem:** Salt Marsh, Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	P	C	C	E	P	P	-	-	E	-	-	-	-
		5. **Other:** None	-	-	-	-	-	-	-	-	-	-	-	-	-
2 – OCEAN BEACH	**Great South Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	C	E	-	E	E	E	-	-	-	-
		2. **Ocean Beach & Dune:** Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	-
		3. **Upland Ecosystem:** Disturbed	-	-	-	-	-	-	-	-	-	P	P	E	-
		4. Bay Ecosystem: Subtidal Bay, SAV	P	C	C	C	-	P	E	-	E	-	-	-	-
		5. **Other:** None	-	-	-	-	-	-	-	-	-	-	-	-	-
3 – WATCH HILL	**Great South Bay**	**1.Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	C	E	-	E	E	E	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	-

TABLE 3
SUMMARY OF TRANSECT CHARACTERISTICS
PHASE 3 CONCEPTUAL SITE MODEL
FIRE ISLAND INLET TO MONTAUK POINT STUDY AREA

TRANSECT	REACH LOCATION	ECOSYSTEMS/HABITATS	Aquatic					Transitional				Terrestrial			
			V	I	F	B	M	V	AR	M	B	V	B	MI	AR
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial	**-**	**P**	**-**	**E**	**-**	**-**	**-**	**-**	**E**	**P**	**E**	**P**	**E**
		4. Bay Ecosystem: Salt Marsh, Intertidal Bay, Sand Shoal/Mudflat & Subtidal Bay	**P**	**C**	**C**	**E**	**P**	**P**	**E**	**P**	**E**	**-**	**-**	**-**	**-**
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
4 – SUNKEN FOREST	**Great South Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore and Marine Intertidal	**-**	**C**	**C**	**E**	**E**	**-**	**E**	**E**	**E**	**-**	**-**	**-**	**-**
		2. **Ocean Beach & Dune:** Beach & Dunes/Swales	**-**	**-**	**-**	**-**	**-**	**E**	**E**	**-**	**E**	**E**	**E**	**E**	**-**
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial, Maritime Forest	**-**	**-**	**-**	**-**	**-**	**-**	**E**	**-**	**-**	**P**	**P**	**P**	**E**
		4. Bay Ecosystem: Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	**P**	**C**	**C**	**E**	**P**	-	**E**	**E**	**E**	-	-	**P**	-
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
5 – WILDERNESS AREA	**Great South Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	**-**	**C**	**C**	**E**	**E**	**-**	**E**	**E**	**E**	**-**	**-**	**-**	**-**
		2. **Ocean Beach & Dune:** Beach, Dunes/Swales	**-**	**-**	**-**	**-**	**-**	**E**	**E**	**-**	**E**	**E**	**E**	**E**	**-**
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**P**	**E**	**E**	**E**

TABLE 3
SUMMARY OF TRANSECT CHARACTERISTICS
PHASE 3 CONCEPTUAL SITE MODEL
FIRE ISLAND INLET TO MONTAUK POINT STUDY AREA

TRANSECT	REACH LOCATION	ECOSYSTEMS/HABITATS	Aquatic					Transitional				Terrestrial			
			V	I	F	B	M	V	AR	M	B	V	B	MI	AR
		4. Bay Ecosystem: Salt Marsh, Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	P	C	C	E	P	P	E	P	E	-	-	P	-
		5. Other: Coastal Pond	P	C	P	E	-	P	E	-	E	-	-	-	-
6 – OLD INLET POND	**Great South Bay**	**1.Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	C	E	-	E	E	E	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	P	E	-	E	E	E	E	-
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*	-	-	-	-	-	-	-	-	-	P	E	P	E
		4. Bay Ecosystem: Salt Marsh, Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	P	C	C	E	P	P	-	P	E	-	-	P	-
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
7 – PIKES BREACH	**Moriches Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	E	E	-	E	P	E	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	-
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial, Disturbed	-	-	-	-	-	-	-	-	-	P	E	P	E
		4. **Bay Ecosystem:** Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	P	C	C	E	P	P	E	P	E	-	-	-	-
		5. **Other:** None	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 3
SUMMARY OF TRANSECT CHARACTERISTICS
PHASE 3 CONCEPTUAL SITE MODEL
FIRE ISLAND INLET TO MONTAUK POINT STUDY AREA

TRANSECT	REACH LOCATION	ECOSYSTEMS/HABITATS	Aquatic					Transitional				Terrestrial			
			V	I	F	B	M	V	AR	M	B	V	B	MI	AR
8 – MORICHES INLET	**Moriches Bay**	**1.Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	E	E	-	E	P	E	-	-	-	-
		2. Ocean Beach & Dune: Beach and Dunes/Swales	E	-	-	E	-	-	E	-	E	P	E	E	E
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial	-	-	-	-	-	-	-	-	E	P	E	P	E
		4. Bay Ecosystem: Intertidal Bay, Sand Shoal/Mudflat & Subtidal Bay, Inlets	P	C	C	-	P	P	-	P	E	-	-	-	-
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
9 – WEST-HAMPTON GROIN FIELD	**Moriches Bay**	**1.Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	E	E	-	E	P	E	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	P	E	E	E
		3. Upland Ecosystem: Upland Terrestrial, Disturbed	-	-	-	-	-	-	-	-	E	-	E	P	E
		4. Bay Ecosystem: Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	P	C	C	-	P	P	-	P	E	-	-	-	-
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
10 – TIANA BEACH	**Moriches Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	E	E	-	E	P	E	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	E

TABLE 3
SUMMARY OF TRANSECT CHARACTERISTICS
PHASE 3 CONCEPTUAL SITE MODEL
FIRE ISLAND INLET TO MONTAUK POINT STUDY AREA

TRANSECT	REACH LOCATION	ECOSYSTEMS/HABITATS	Aquatic					Transitional				Terrestrial			
			V	I	F	B	M	V	AR	M	B	V	B	MI	AR
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial, Disturbed	-	-	-	-	-	-	-	-	E	P	E	P	E
		4. Bay Ecosystem: Salt Marsh, Intertidal Bay, Sand Shoal/Mudflat, SAV, Subtidal Bay,	P	C	C	E	P	P	-	-	E	-	-	-	-
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
11 – WOSI Area	**Shinnecock Bay**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	C	E	-	E	E	E	-	-	-	-
		2. Ocean Beach & Dune: Beach & Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	E
		3. Upland Ecosystem: Mixed Vegetation/*Phragmites*, Upland Terrestrial, Disturbed	-	-	-	-	-	-	-	-	E	P	E	P	E
		4. Bay Ecosystem: Intertidal Bay, Sand Shoal/Mudflat, SAV, Subtidal Bay	P	C	C	E	P	P	-	-	E	-	-	-	-
		5. Other: None	-	-	-	-	-	-	-	-	-	-	-	-	-
12 – GEORGICA POND	**Ponds**	1.**Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	C	C	E	E	-	E	P	E	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	E	E	-	E	E	E	E	E
		3. Upland Ecosystem: Upland Terrestrial	-	-	-	-	-	-	-	-	E	P	E	P	E
		4. Bay Ecosystem: None	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 3
SUMMARY OF TRANSECT CHARACTERISTICS
PHASE 3 CONCEPTUAL SITE MODEL
FIRE ISLAND INLET TO MONTAUK POINT STUDY AREA

TRANSECT	REACH LOCATION	ECOSYSTEMS/HABITATS	Aquatic					Transitional				Terrestrial			
			V	I	F	B	M	V	AR	M	B	V	B	MI	AR
		5. Other: Coastal Pond	**P**	**C**	**P**	**E**	-	**P**	-	-	**E**	-	-	-	-
13 – SAGAPONAK, POTATO ROAD VICINITY	**Ponds**	**1.Coastal Marine Ecosystem:** Offshore, Nearshore, Marine Intertidal	-	**C**	**C**	**E**	**E**	-	**E**	**P**	**E**	-	-	-	-
		2. Ocean Beach & Dune: Beach, Dunes/Swales	-	-	-	-	-	**E**	**E**	-	**E**	**E**	**E**	**E**	-
		3. Upland Ecosystem: Upland Terrestrial, Disturbed	-	-	-	-	-	-	-	-	**E**	**P**	**E**	**P**	**E**
		4. Bay Ecosystem: Intertidal Bay, Sand Shoal/Mudflat, Subtidal Bay	**P**	**C**	**C**	**E**	**P**	**P**	-	-	**E**	-	-	**P**	-
		5. Other: Fresh Water Wetland, Coastal Pond	**P**	**C**	**P**	**E**	-	**P**	-	-	**E**	-	-	-	-

(1) Transect numbers correspond with Appendix B tables.
(2) Endpoints: V=Vegetation, I=Invertebrates, F=Finfish, B=Birds, M=Mammals, AR=Amphibians & Reptiles, MI=Terrestrial Mammals & Insects, P=Present but with no special significance, C=Commercially & Recreationally Important endpoints may be present, E=Endangered or Threatened Species may be present.
(3) More detail on relevant endpoints is provided in Table 1.

Table 4

Summary of Barrier Island Processes Potentially Affected by Project & Restoration Features
Phase 3 Conceptual Model
Fire Island Inlet to Montauk Point

Project Features	Barrier Island Processes				
	Longshore Transport	Cross Island Transport	Dune Develop-ment and Evolution	Bayside Shoreline Processes	Estuarine Processes
Groin Alteration and Construction	X	X	X		
Beach Nourishment/Renourishment	X	X	X		
Dune Modification		X	X		
Dredging					X
Bulkhead/Seawall Construction	X	X	X	X	
Inlet Sand Bypassing	X	X	X	X	X
Nonstructural Features	X	X	X		
Upland Restoration		X	X		
Island Restoration	X	X	X	X	X
Planting/Invasive Species Control		X	X	X	X
Bayside Shoreline Processes				X	X
Tidal Marsh Restoration				X	X
SAV Restoration				X	X

Appendix A

Phase 2 Model: Summary, Driver/Stressor Definitions, and Models

Summary of the Development of the Phase 2 Conceptual Model

Fire Island Inlet To Montauk Point Study Area

The Conceptual Model for the Fire Island Inlet to Montauk Point (FIMP) Reformulation Study was developed in three phases. Phase 1 comprehensively identified and defined the universe of potential components that might be relevant to the Model. Phase 2 focused and refined the individual habitat models developed in Phase 1. In Phase 3, site and project feature specific information is incorporated to focus the EIS effort and provide for thorough and environmentally sound impact assessment.

The purpose of the Phase 2 effort was to refine and focus the Phase 1 work in a systematic review. All ecosystems, habitats, drivers, stressors, and endpoints were assessed with the goal of developing models that could be more readily applied to the indigenous habitats and alternative management options being considered for the reaches of the study area. The comprehensive Phase 1 habitat list was revisited to develop a representative list of habitats that occur within the study area. Conceptual models for 14 habitats within four ecosystems (18 total models) of the FIMP study area were developed for use as an assessment tool to delineate complete linkages or pathways between important drivers, stressors and endpoints that should be further investigated as part of the EIS. Each ecosystem and each habitat and interrelated component endpoints within each habitat are unique, and potentially vulnerable to an ecosystem-specific set of drivers and stressors developed for each model. FIMP relevant endpoints with societal value and/or that meet a policy goal include loss of an endangered species or its habitat, reproductive potential of a species important for commerce or recreation, attributes that support food sources or flood control, wetlands, and rare habitats or ecosystems. The potential for impacts to a specific ecosystem or habitat and its endpoints is dependent upon the final selection of alternatives.

Key components of the Phase 2 approach maintained stakeholder input in the model development that was begun in Phase 1, while carefully scrutinizing natural and relevant anthropogenic characteristics of the study area. Consideration of both system-specific characteristics and stakeholder input assures all environmental concerns were addressed in the process.

Similarly, the comprehensive lists of drivers and stressors identified in Phase 1 were reviewed to identify and recommend modification to refine and focus the driver/stressor relationships to support the EIS process. A driver is any natural or human activity that can lead to or result in an environmental stressor; i.e., any physical, chemical and/or biological change experienced by an ecosystem. A stressor is an agent of change, and for the purposes of the FIMP study can be positive or negative. The refinement of drivers resulted in the final incorporation of three Natural and six Anthropogenic Drivers into the Phase 2 Conceptual Model. Stressors were selected and incorporated into the model representing changes in physical, hydrological, water quality, biological and human aspects of the ecosystems. This Appendix provides the list and definitions of drivers and stressors developed in the Phase 2 Conceptual Model, as well as, the 18 models that provide an essential element for the development of the Phase 3 Conceptual Model. The intent is to provide sufficient background leading to the development of the Phase 3 Conceptual Model. The four ecosystems identified in Phase 1, Coastal Marine, Ocean Beach and Dune, Bay, and Barrier Island Upland, were retained for inclusion in the Phase 2 Conceptual Model, but in some cases, the habitats within each of the respective ecosystems were redefined, resulting in a total of 18 habitat models within four ecosystems. The 18 models are provided for reference as part of this appendix.

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Table A1

Definition of Drivers and Stressors

Phase 2 Conceptual Model – Fire Island Inlet to Montauk Point

NATURAL DRIVERS:

1. **Catastrophic Storms:** Storms can dramatically and catastrophically change the ecosystem or shoreline structures; storms can be either Nor-Easters or hurricanes.

2. **Climate Change:** This driver includes changes from natural causes only and is not used in the context of a stressor or habitat response. It includes all manifestations of climatic change, from global warming to changes in precipitation, or other effects.

3. **Sea Level Rise:** Increase in sea level due to environmental changes such as global warming and other geologic causes, over the next 50 years.

ANTHROPOGENIC DRIVERS:

1. **Development:** Includes development of buildings, marinas, roads; resultant alteration of run-off and nutrient loading (including all non-point source pollution). Development yields decreased (natural) habitat availability to natural biological populations. Solid waste and impervious surfaces increase with development. This definition of development includes primary structures only (houses, roads, etc.) not accessory structures (bulkheads etc.) that are addressed under the Construction drivers.

2. **Agriculture/Aquaculture:** Harvesting or other forms of resource consumption (including commercial harvesting) of marine and terrestrial species that may result in habitat alteration (e.g., introduction of new species).

3. **Recreation and Land Use**: Refers to land use by humans that is associated with recreation not covered under development, including camping, boating, land use by vehicles, human presence and disturbance (of natural habitats and species), fishing and camping. As such, all associated visitor impacts are also included (such as the introduction of nuisance and/or non-native species).

4. **Construction**: This activity is broken into three separate drivers that all include the construction of some type of engineered device or land alteration. The three types of construction are Hard, Soft, and Dredging:

   (4a) **Construction-Hard:** includes seawalls, bulkheads, groins, jetties and other types of permanent shoreline alteration.

   (4b) **Construction-Soft**: includes beach replenishment, dune enhancement, various restoration measures such as plantings, structural removal and habitat creation, restoration plantings and other types of permanent and temporary shoreline alteration.

   (4c) **Construction-Dredging:** includes only the actual dredging operation of removal of offshore and nearshore sediment and sand. This does not include the placement of sand or machinery impacts.

Table A1

Definition of Drivers and Stressors

Phase 2 Conceptual Model – Fire Island Inlet to Montauk Point

PHYSICAL STRESSORS

This category includes all relevant stressors that could impart a physical change to the habitat or ecosystem. Two Physical Stressors are included in the conceptual models:

1. **Breach Formation:** refers to the condition where severe overwashing erodes a new inlet permitting exchange of ocean and bay waters under normal tidal conditions. While overwashing can lead to breach formation they are distinct events.
2. **Habitat Alteration:** refers to the loss, fragmentation, or conversion of habitat from one type to another whether through natural or anthropogenic drivers. This includes shoreline change, accretion, and erosion from sedimentation.

HYDROLOGICAL STRESSORS

These stressors act through any change in ocean or bay hydrology. Since water can be a medium in sedimentation patterns, all Hydrological Stressors may include changes in sedimentation patterns. Five Hydrological Stressors are included in the conceptual models:

1. **Changes in Overwash Regime:** is a change in the temporal, spatial or severity of the temporary overtopping of the barrier island by tides and/or waves during a storm.
2. **Flooding:** is an inundation event where ocean or bay waters rise to a level above mean high tide; flooding relates only to inundation due to catastrophic storms and sea level rise.
3. **Hydrological Alteration:** is a change in the frequency, duration, and severity of the pattern and availability of ocean or bay water. This does not include a sole inundation or drought event.
4. **Change in Wave Dynamics:** refers to a long-term change in the frequency, duration, direction and/or intensity of ocean and bay waves. Change in wave dynamics includes the “scour” effect.
5. **Circulation Changes:** refers to any change in water movement patterns from the water along shore and the flushing dynamics of bays and their habitats.

WATER QUALITY STRESSORS

These stressors result in a change to any aspect of the chemical or nutrient quality of ocean or bay water. Seven Water Quality Stressors are included in the conceptual models:

1. **Changes in Salinity:** refers to bay, tidal, or coastal pond systems where salinity changes might affect the survival and reproduction of plants and animals with specific salinity tolerance ranges.
2. **Changes in Nutrient Concentrations:** refers to any alteration of nutrient levels in ocean or bay waters, or distribution relative to typical regional conditions, particularly

with respect to aquatic and marine and plant communities. Eutrophication is an extreme case of changes in nutrient concentrations.

3. **Contaminants:** refers to alteration of nature and/or extent of concentrations of toxic substances in the aquatic or marine environment relative to typical regional conditions. Examples of toxic substances include metals, organics, or pesticides. Acidification effects of acid rain on small ponds is also included in this stressor.
4. **Changes in Sedimentation:** refers to both the frequency, distribution pattern and amount of sediment loads, suspended sediments and sediment transport. While this stressor is included in the Water Quality category because increased suspended sediments cause negative effects on water quality through turbidity and sediment-associated contamination, it also addresses stressors such as erosion and accretion. (Note: In future model development, sedimentation may be separated out to be included in areas of habitat alteration resulting from either hydrological or physical stressors.)
5. **Turbidity:** refers to the continuous or long term condition of reduced water clarity caused by either the growth of phytoplankton or the presence of suspended sediments in the water column (e.g., bays and marinas with constant, heavy boat traffic).
6. **Reduced Dissolved Oxygen (DO):** refers to the condition of a lowering of the optimal ambient levels of dissolved oxygen necessary to sustain aquatic and marine life, to a level that may impair communities ability to maintain and reproduce.
7. **Changes in Water Temperature:** refers to a general increase or decrease in air temperature resulting from global climate change or other extreme climatic variability that results in a long term extreme change in ocean or bay water temperature.

BIOLOGICAL STRESSORS

Stress associated with these elements is related to effects associated with a change in biological components of the system. Two Biological Stressors are included in the models:

1. **Species Displacement:** is the relocation of any existing floral or faunal species by either natural or anthropogenic activities. This can include the introduction of nuisance or non-native species.
2. **Harmful Algal Blooms:** applies not only to toxic microscopic algae but also to benthic or planktonic macroalgae which can proliferate in response to anthropogenic nutrient enrichment, leading to major ecological impacts such as the displacement of indigenous species, habitat alteration, or oxygen depletion. Stressor does not include growth of phytoplankton that might create turbidity.

HUMAN STRESSORS

Table A1

Definition of Drivers and Stressors

Phase 2 Conceptual Model – Fire Island Inlet to Montauk Point

Stress associated with specific human activities. Only one Human Stressor is included in the models:

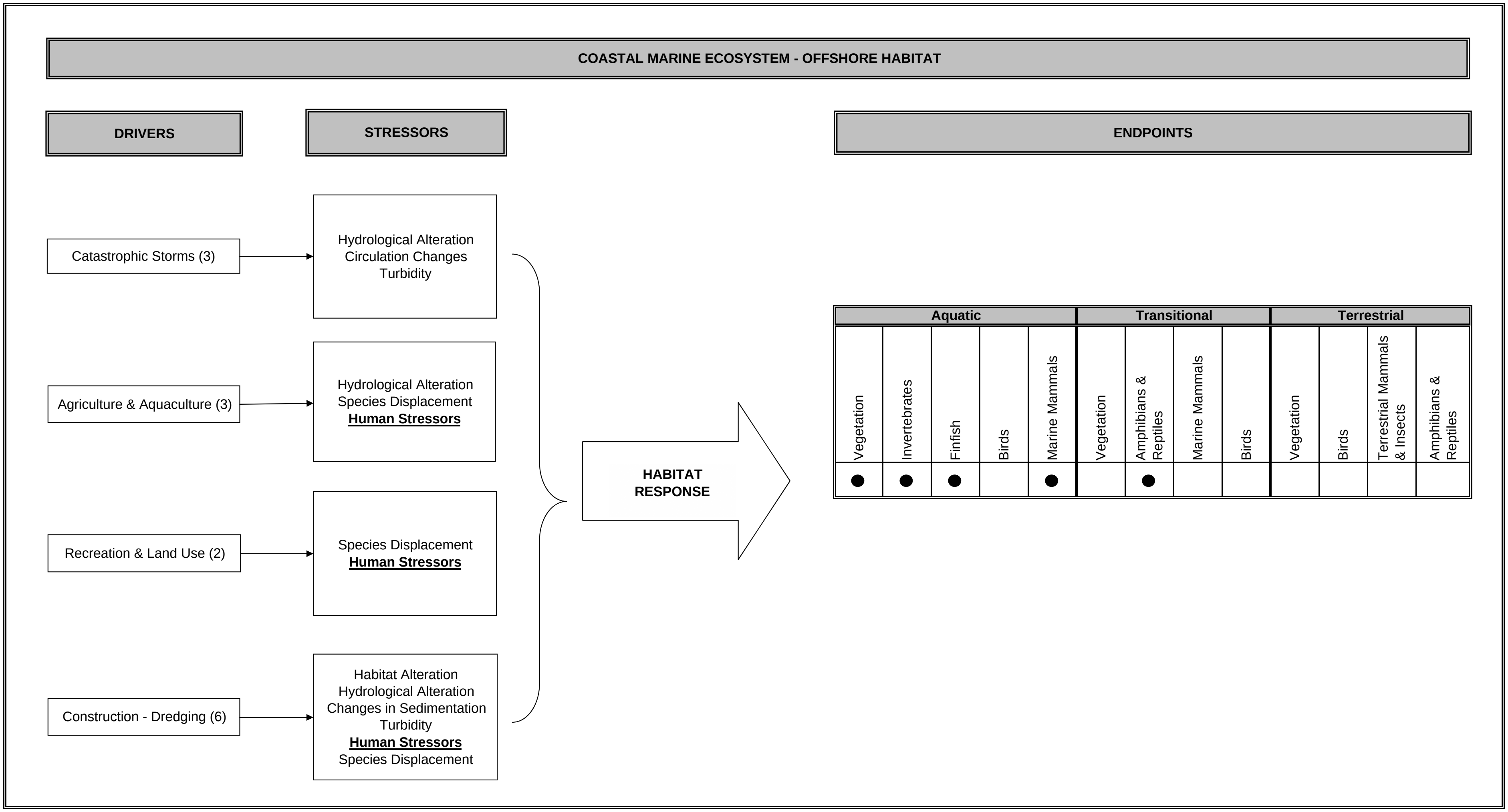
1. **Human Presence:** represents direct and indirect impacts as a result of human disturbance to the natural plant and animal communities and their associated habitats. Generation of solid waste, noise, over-exploitation of resources, or pollution, and air quality degradation are all examples of Human Presence. Human Presence is considered to be less severe than related Anthropogenic Drivers listed, and focuses on stress as a result of regular daily use of a habitat.

OTHER STRESSORS

These miscellaneous stressor elements were put in this category since no single existing category was appropriate. Two Other Stressors are included in the models:

1. **Salt Deposition:** refers to sea salt deposit from spray on vegetation in beach, dune, and maritime communities.
2. **Groundwater Regime:** relates to a alteration of either groundwater inputs to fresh or saltwater areas, depth to groundwater for plant growth, or other stress relating to the availability of groundwater.
3. **Changes in Fire Regime:** would indicate not just a single fire, but rather a change in the frequency and/or severity of fires in that system. Many organisms are adapted to a specific fire regime, and cannot survive when this regime is altered.

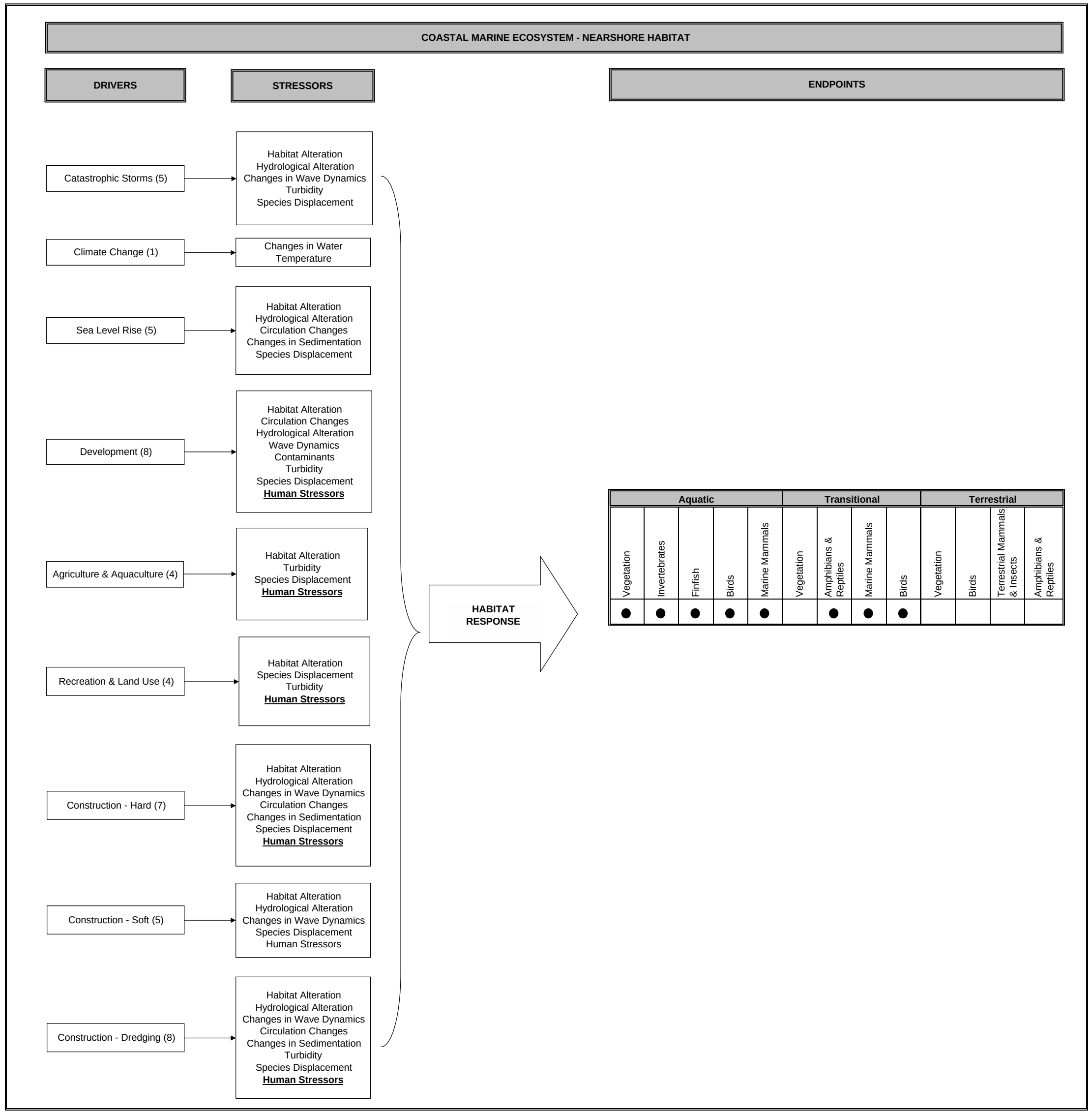
Figure A1
Coastal Marine Ecosystem - Offshore Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
●	●	●		●		●						

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

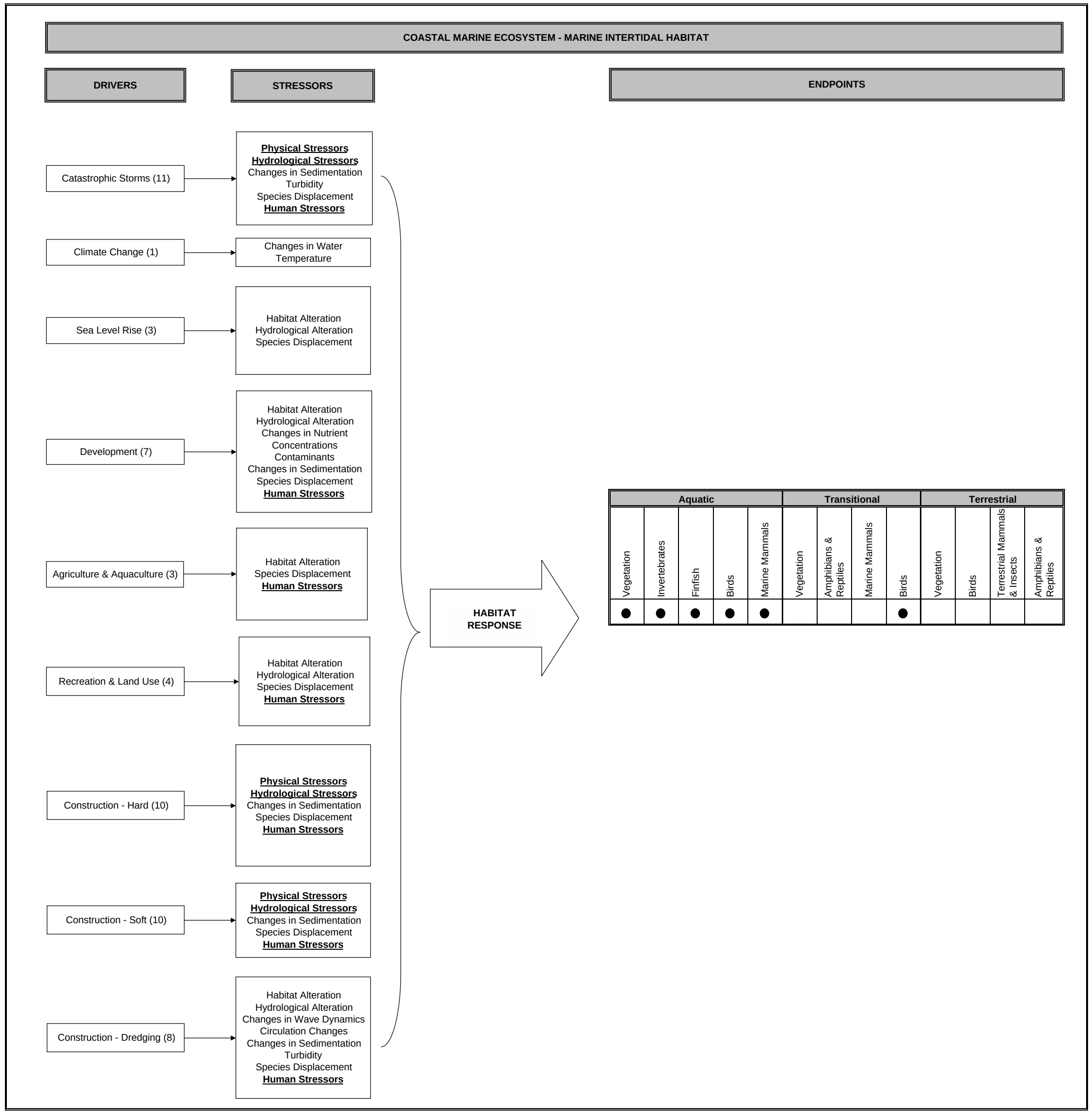
Figure A2
Coastal Marine Ecosystem - Nearshore Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
●	●	●	●	●		●	●	●				

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

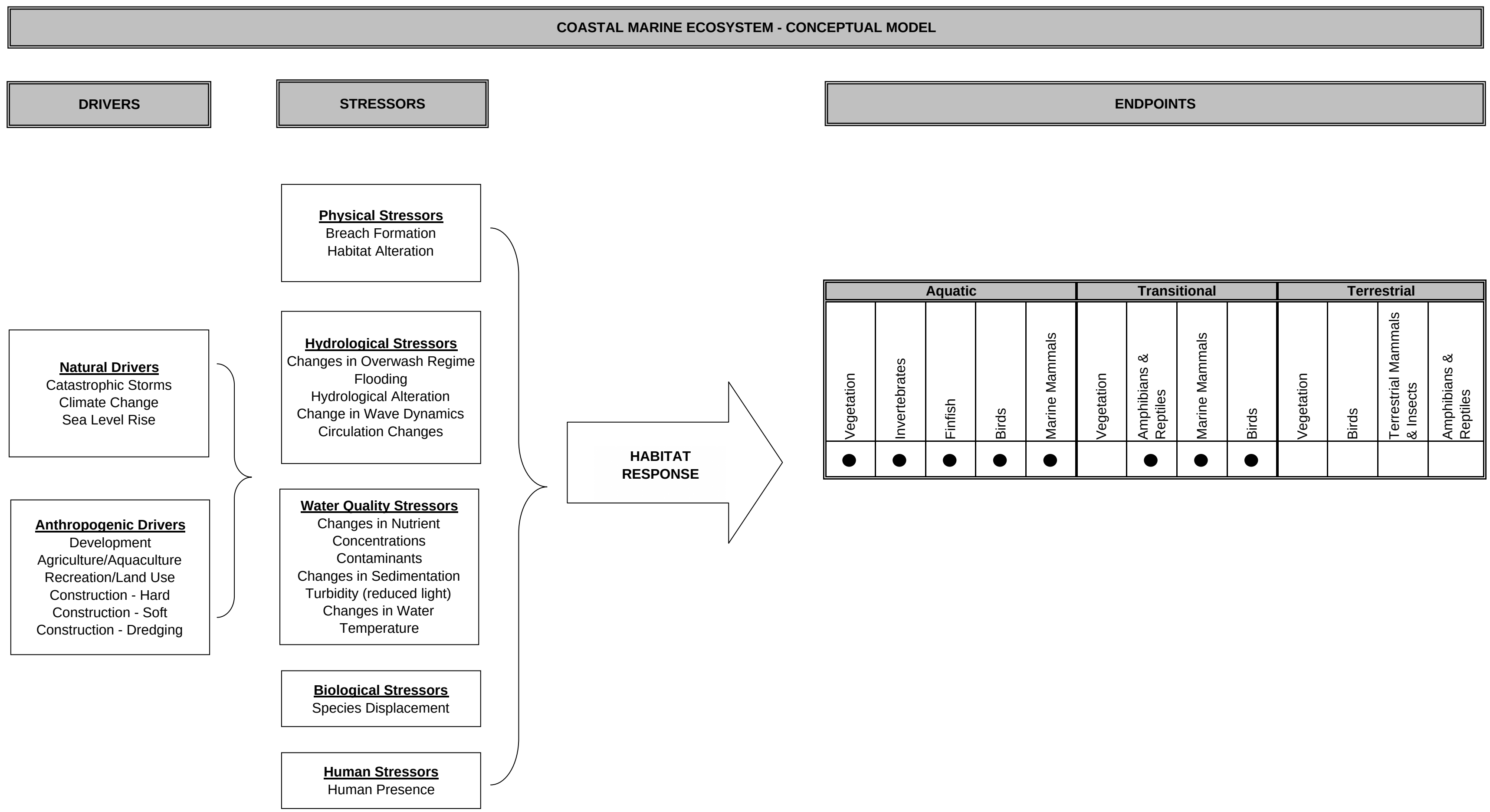
Figure A3
Coastal Marine Ecosystem - Marine Intertidal Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
●	●	●	●	●				●				

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.
Aquatic Vegetation and Marine Mammals are relevant endpoints to Marine Intertidal Habitats with rocky substrate.

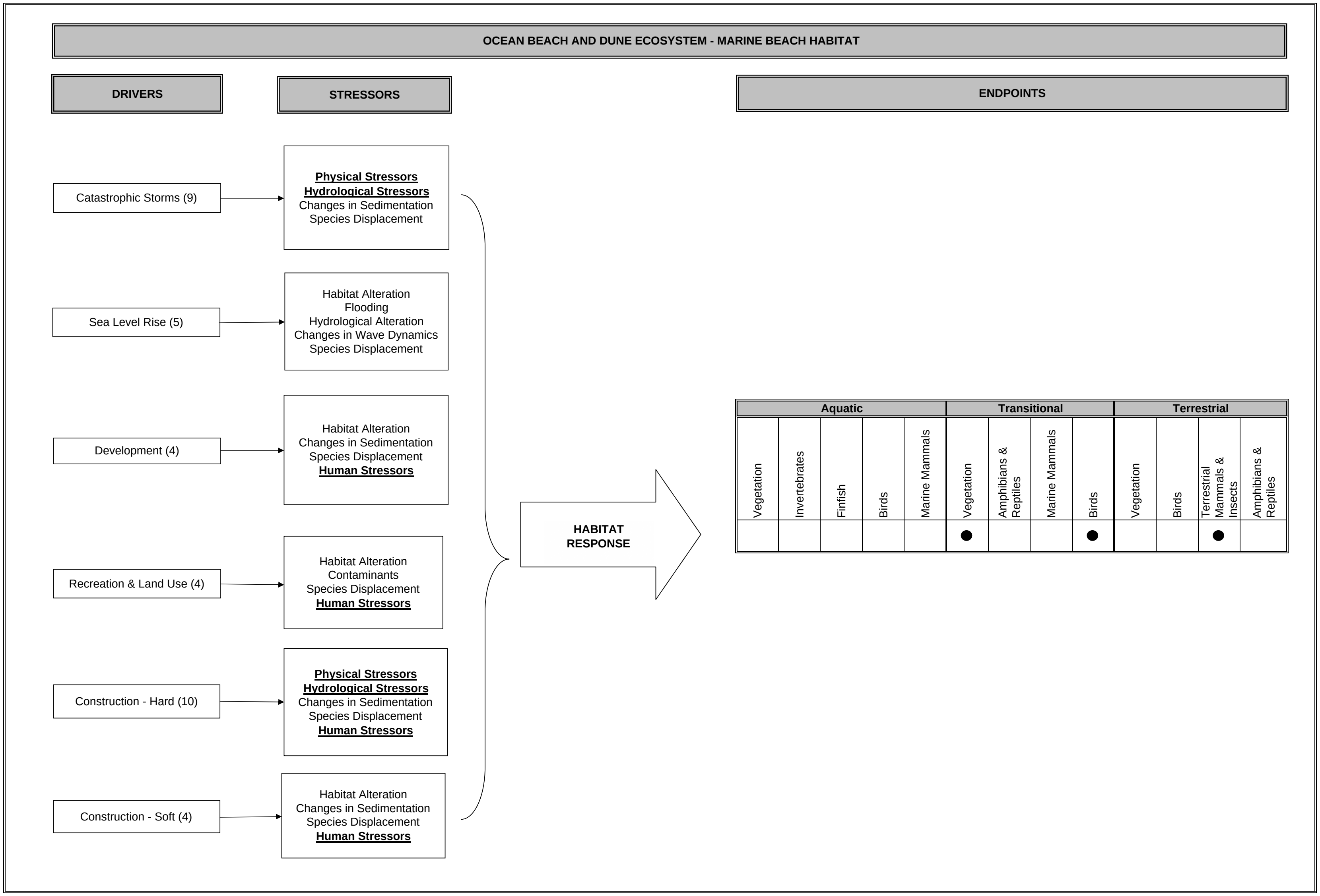
Figure A4
Coastal Marine Ecosystem - Conceptual Model
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
●	●	●	●	●		●	●	●				

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.
Aquatic Vegetation and Marine Mammals are relevant endpoints to Marine Intertidal Habitats with rocky substrate.

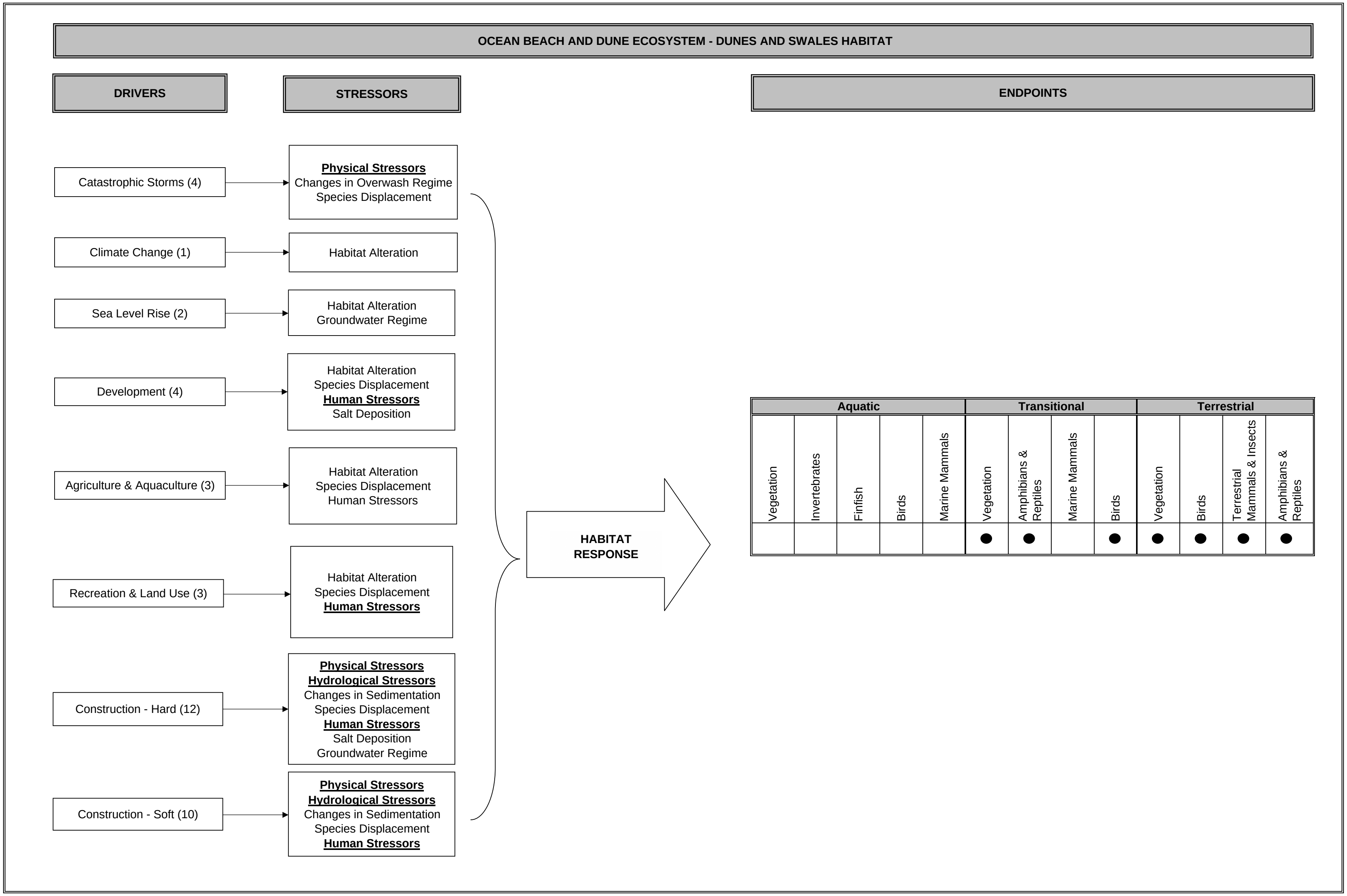
Figure A5
Ocean Beach and Dune Ecosystem - Marine Beach Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
					●			●			●	

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

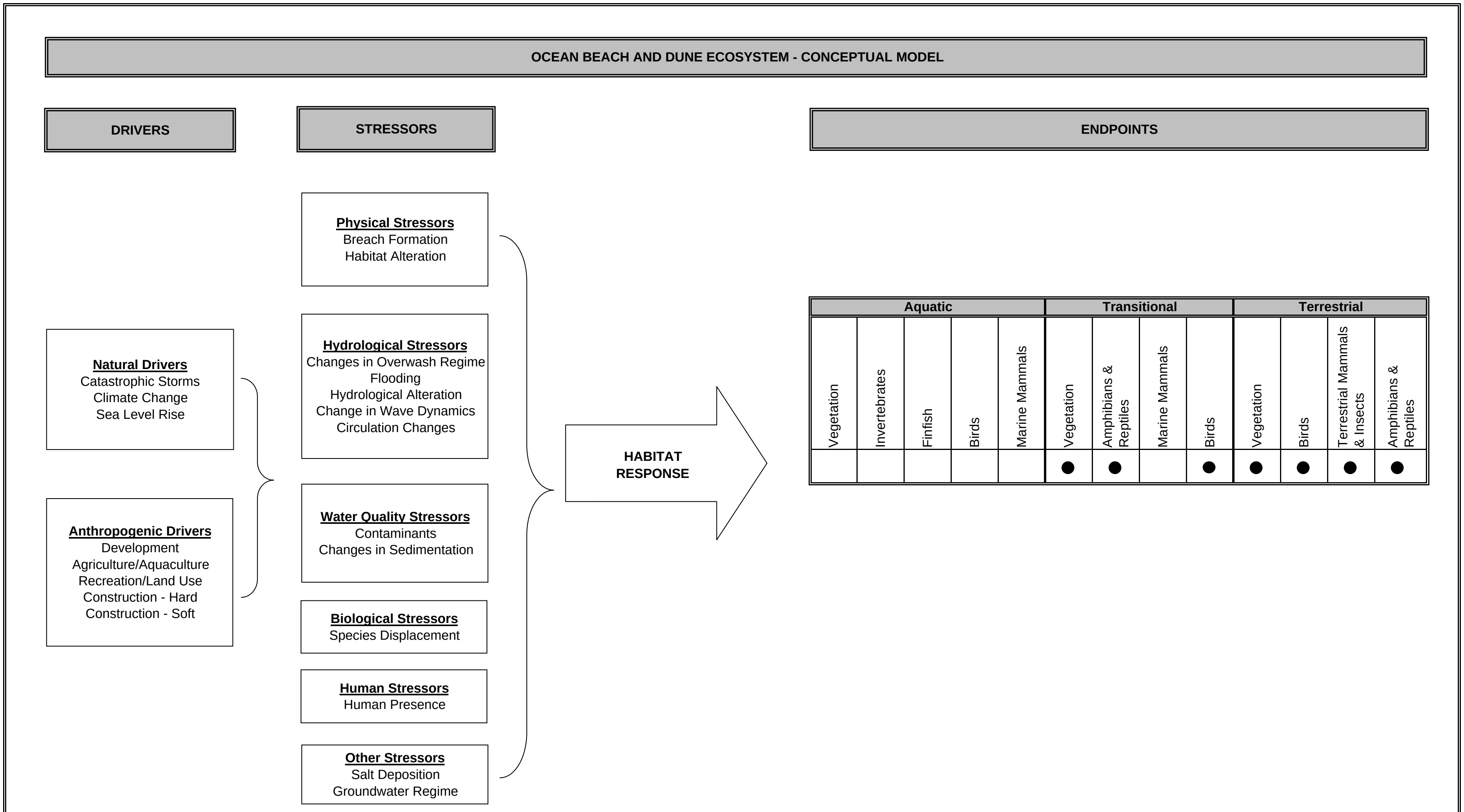
Figure A6
Ocean Beach and Dune Ecosystem - Dunes and Swales Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
					●	●		●	●	●	●	●

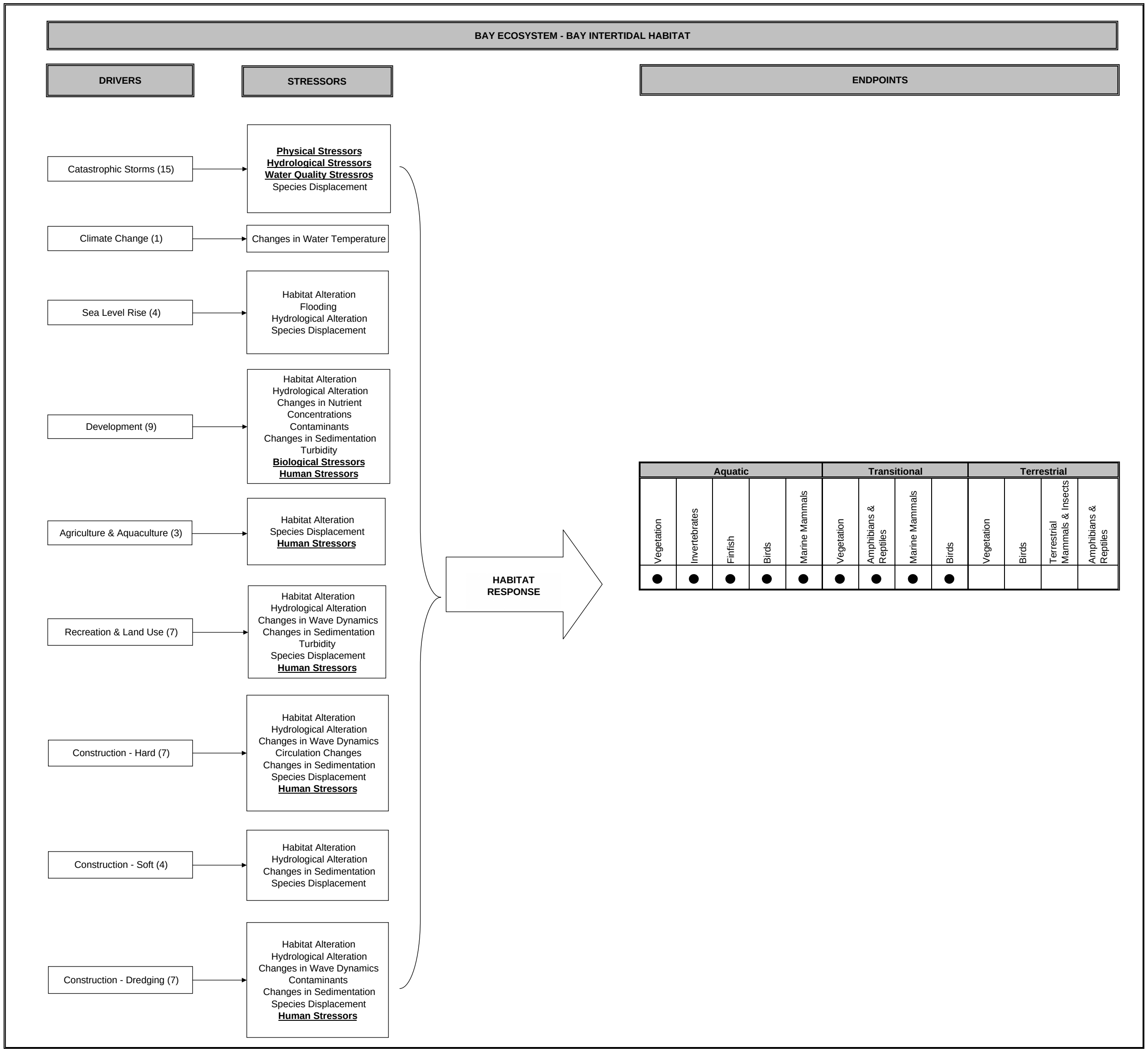
Note: Numbers in parentheses indicate the number of stressors associated with that driver. Stressors that appear in underlined bold indicate that all stressors in that category apply.

Figure A7
Ocean Beach and Dune Ecosystem - Conceptual Model
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



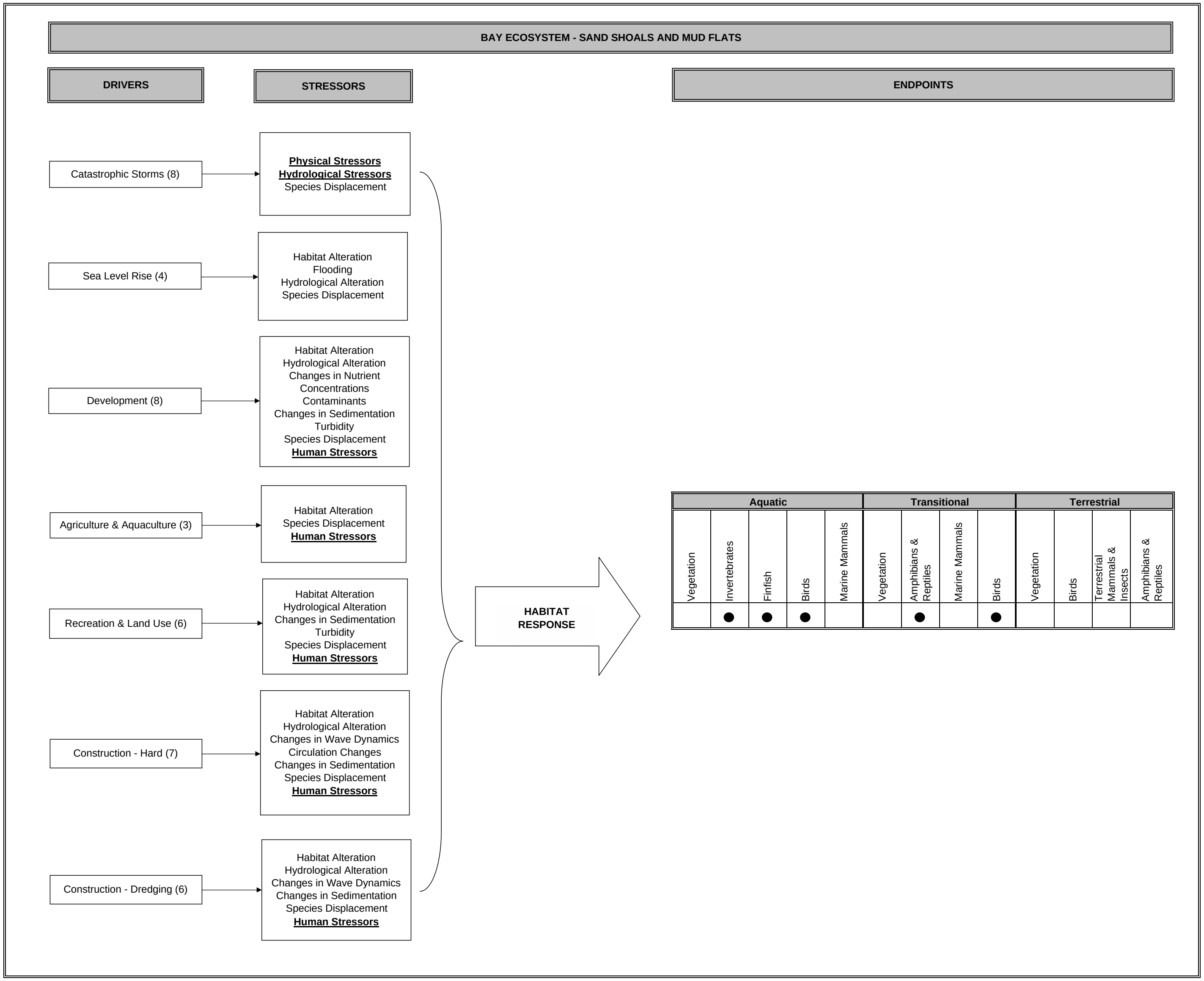
Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

Figure A8
Bay Ecosystem - Bay Intertidal Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

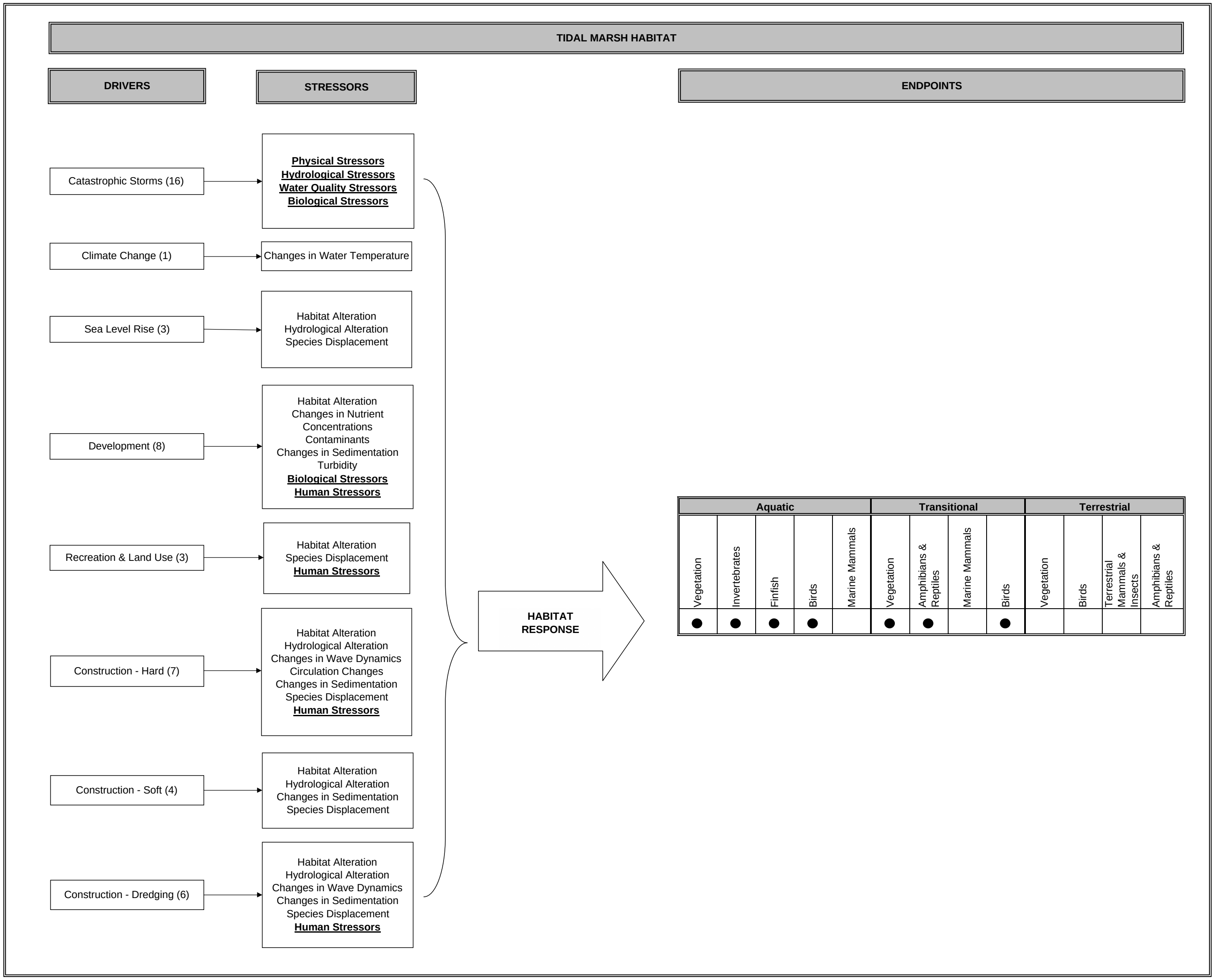
Figure A9
Bay Ecosystem - Sand Shoals and Mud Flats
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
	●	●	●			●		●				

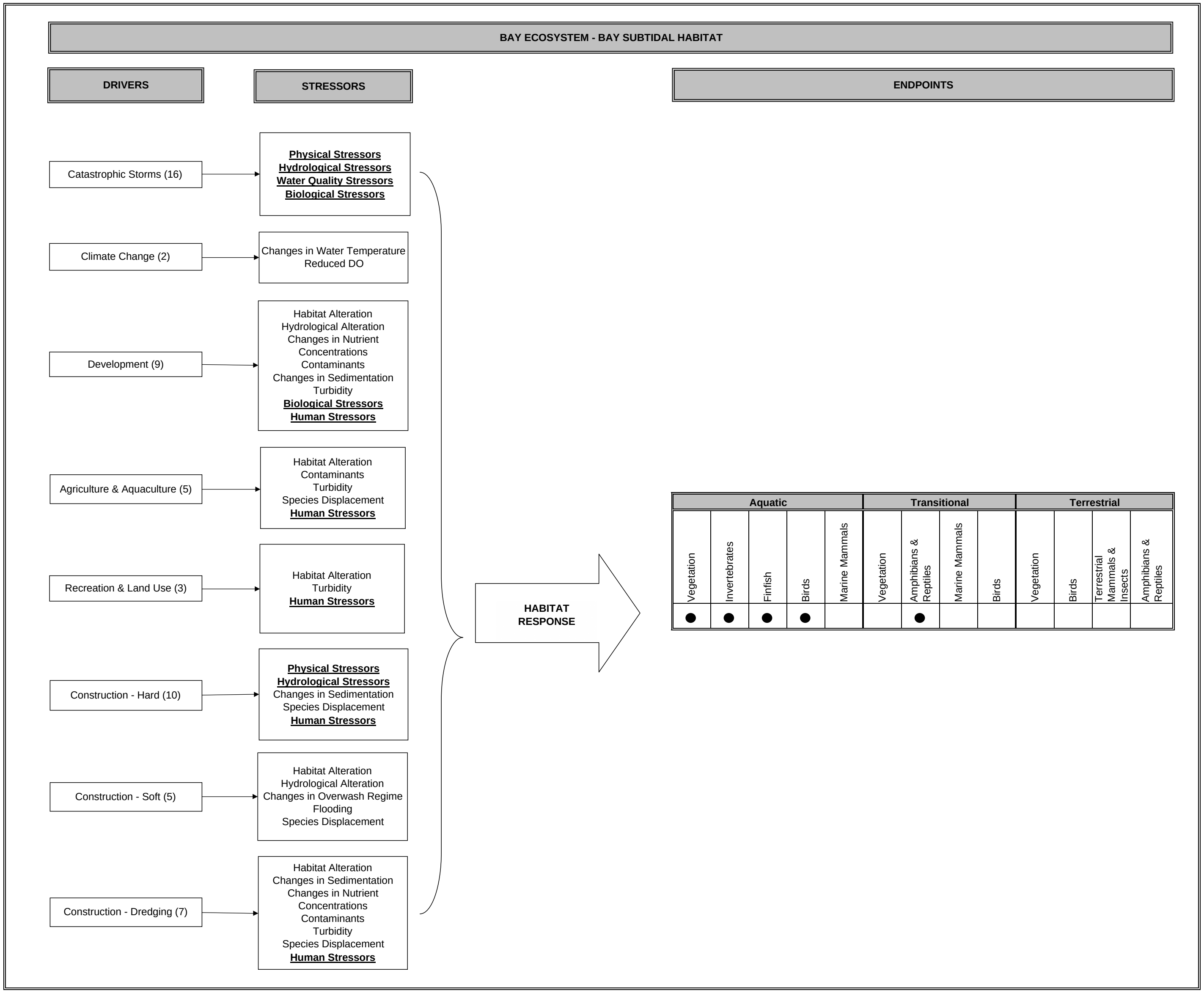
Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

Figure A10
Bay Ecosystem - Tidal Marsh Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



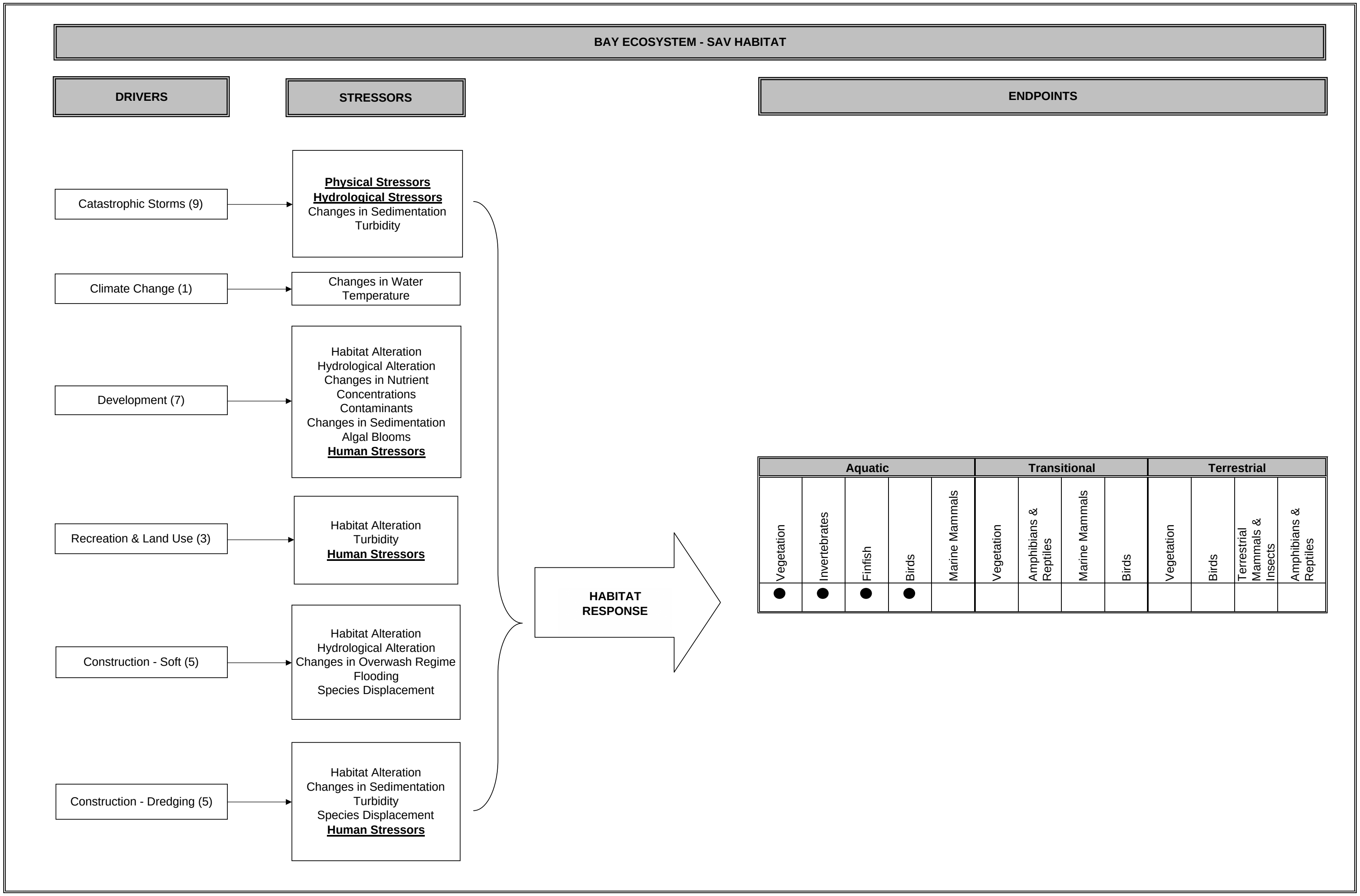
Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

Figure A11
Bay Ecosystem - Bay Subtidal Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



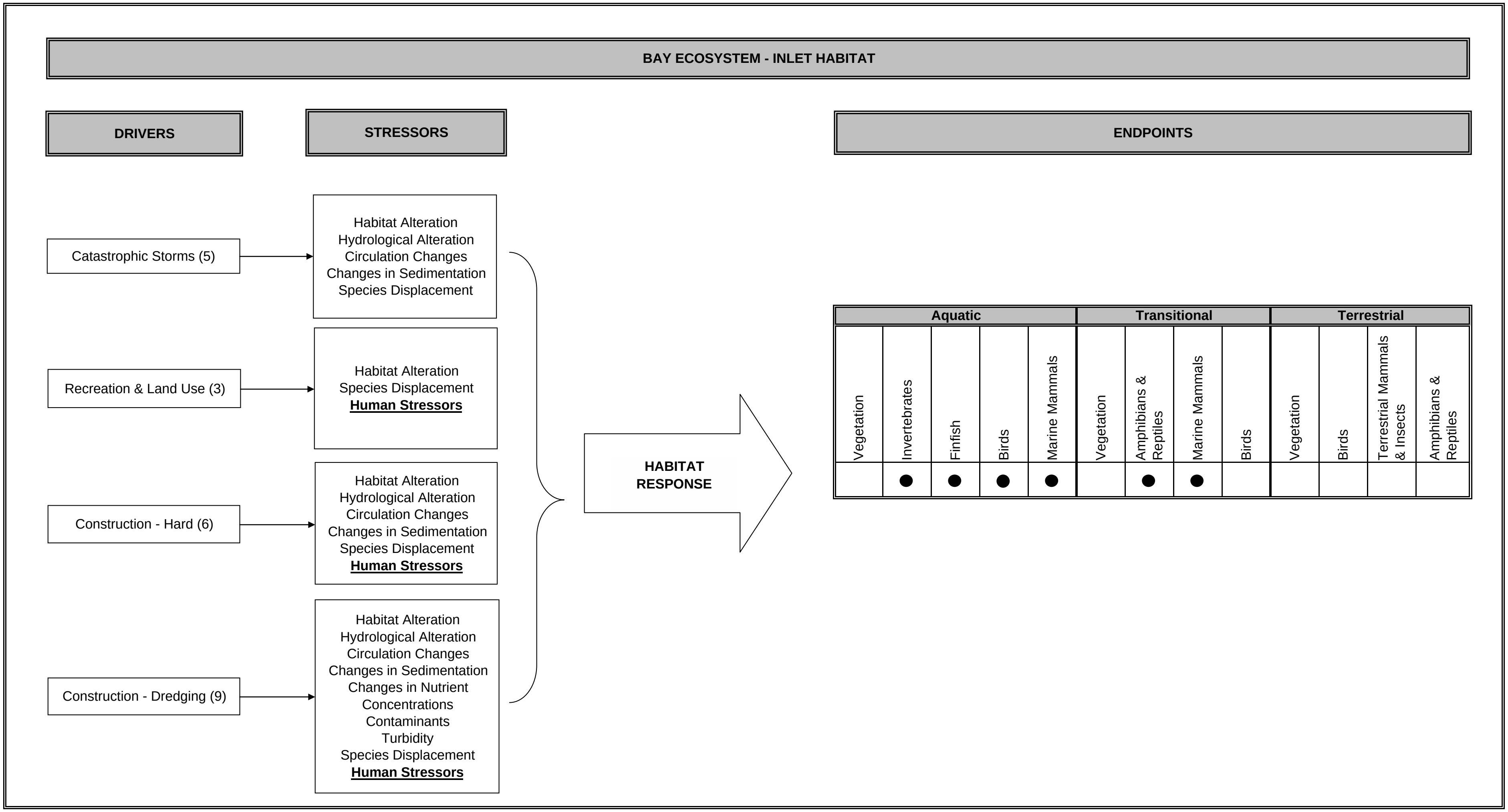
Note: Numbers in parentheses indicate the number of stressors associated with that driver.

Figure A12
Bay Ecosystem - SAV Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

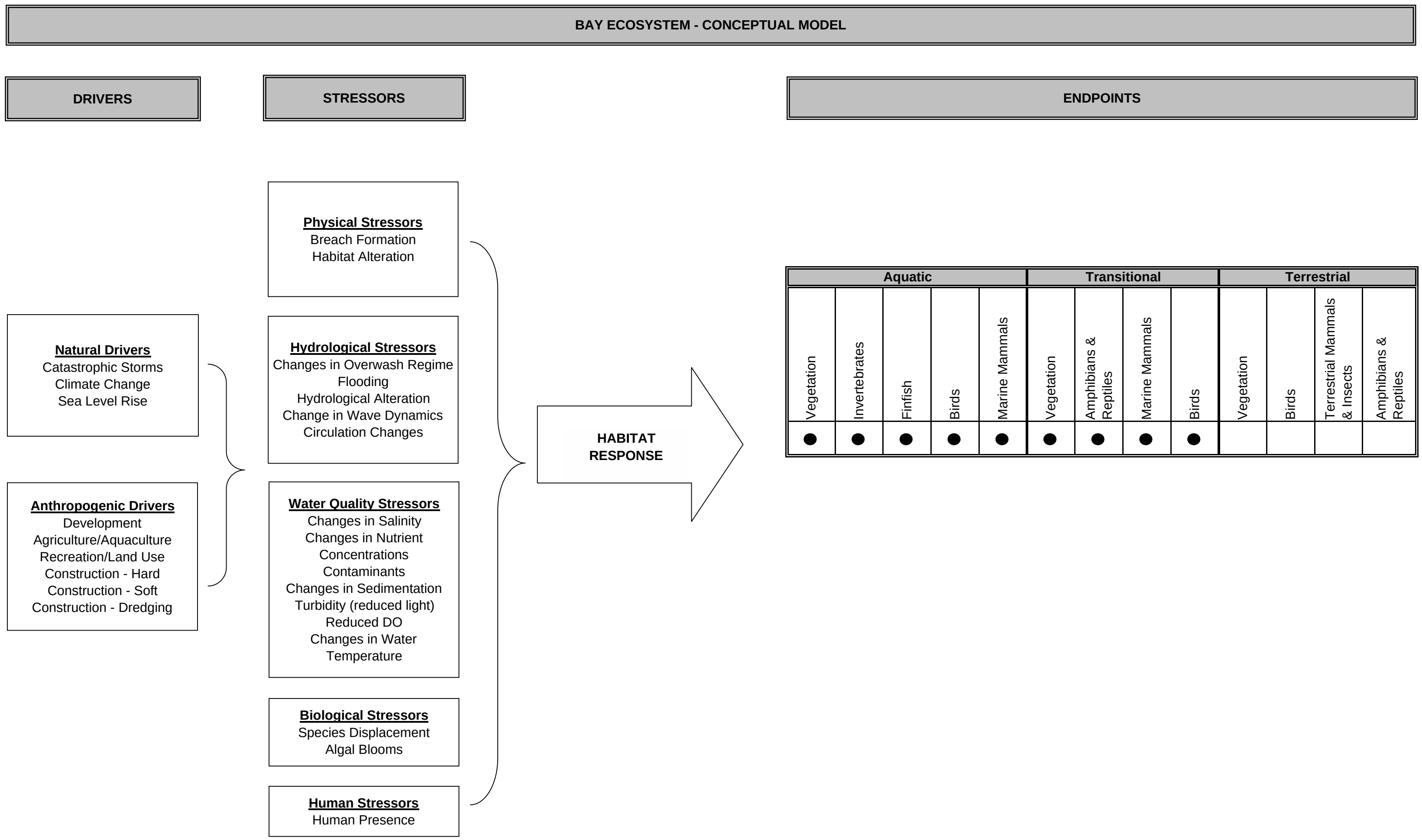
Figure A13
Bay Ecosystem - Inlet Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
	●	●	●	●		●	●					

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

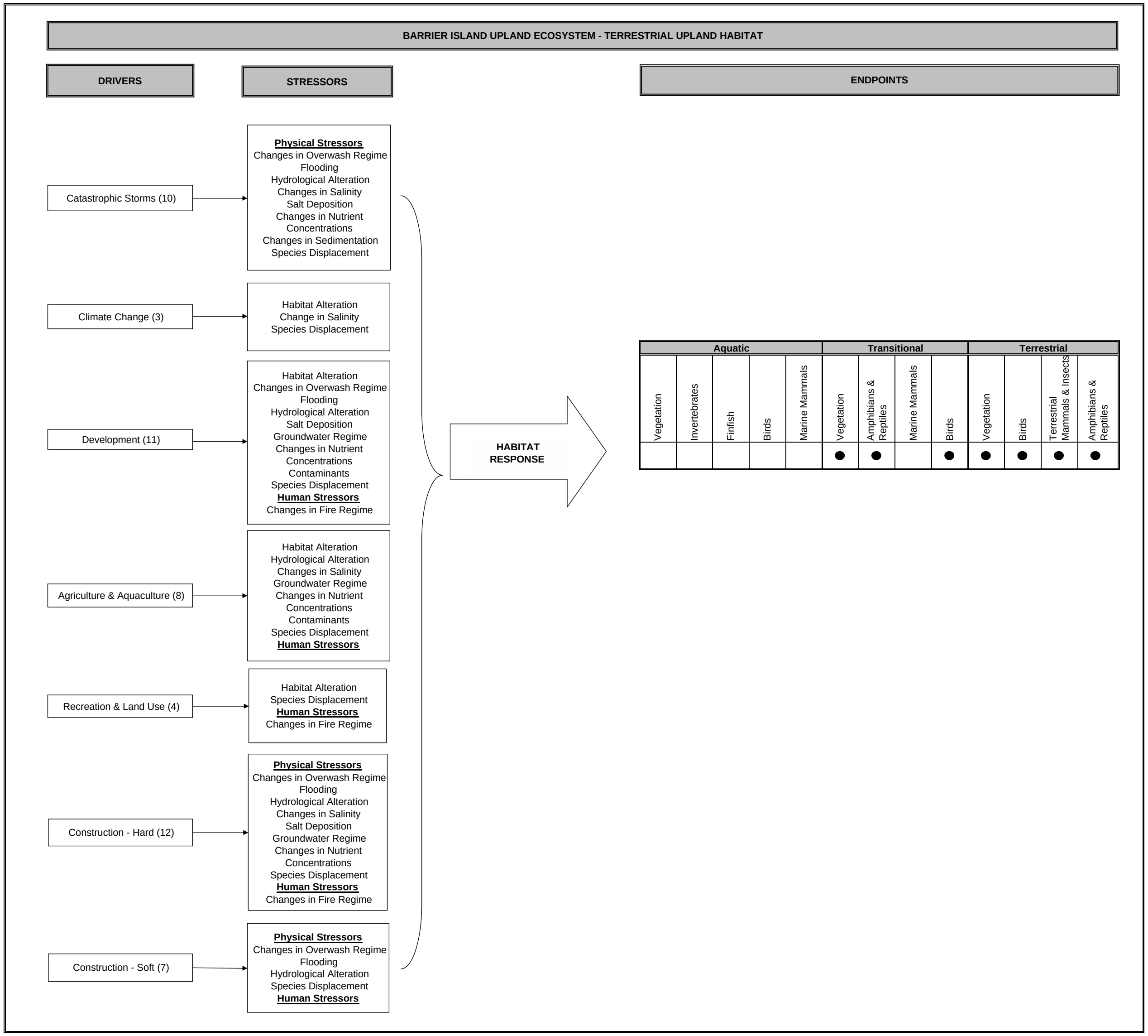
Figure A14
Bay Ecosystem - Conceptual Model
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
●	●	●	●	●	●	●	●	●				

Note: Numbers in parentheses indicate the number of stressors associated with that driver;Stressors that appear in underlined bold indicate that all

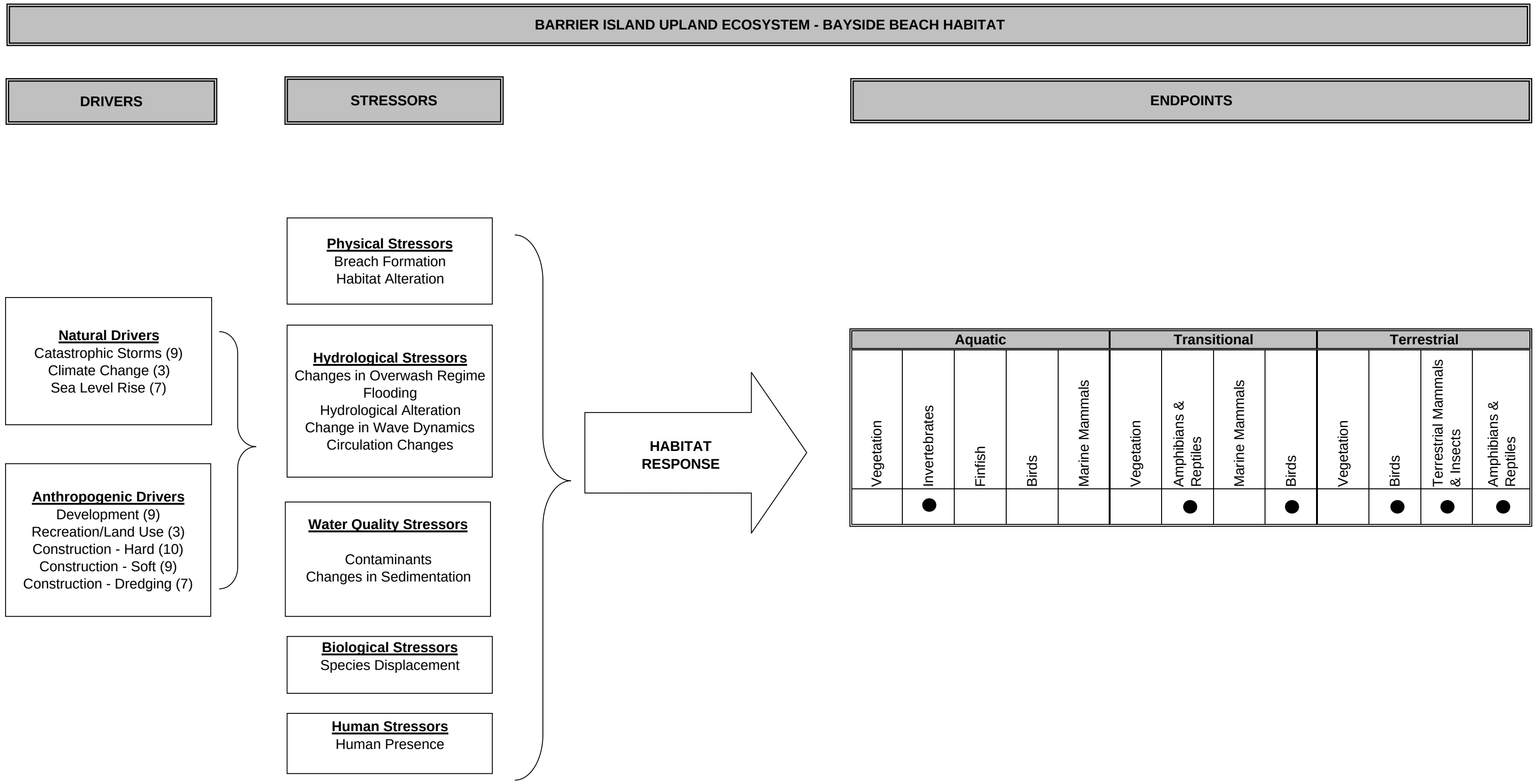
Figure A15
Barrier Island Upland Ecosystem - Terrestrial Upland Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
					●	●		●	●	●	●	●

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

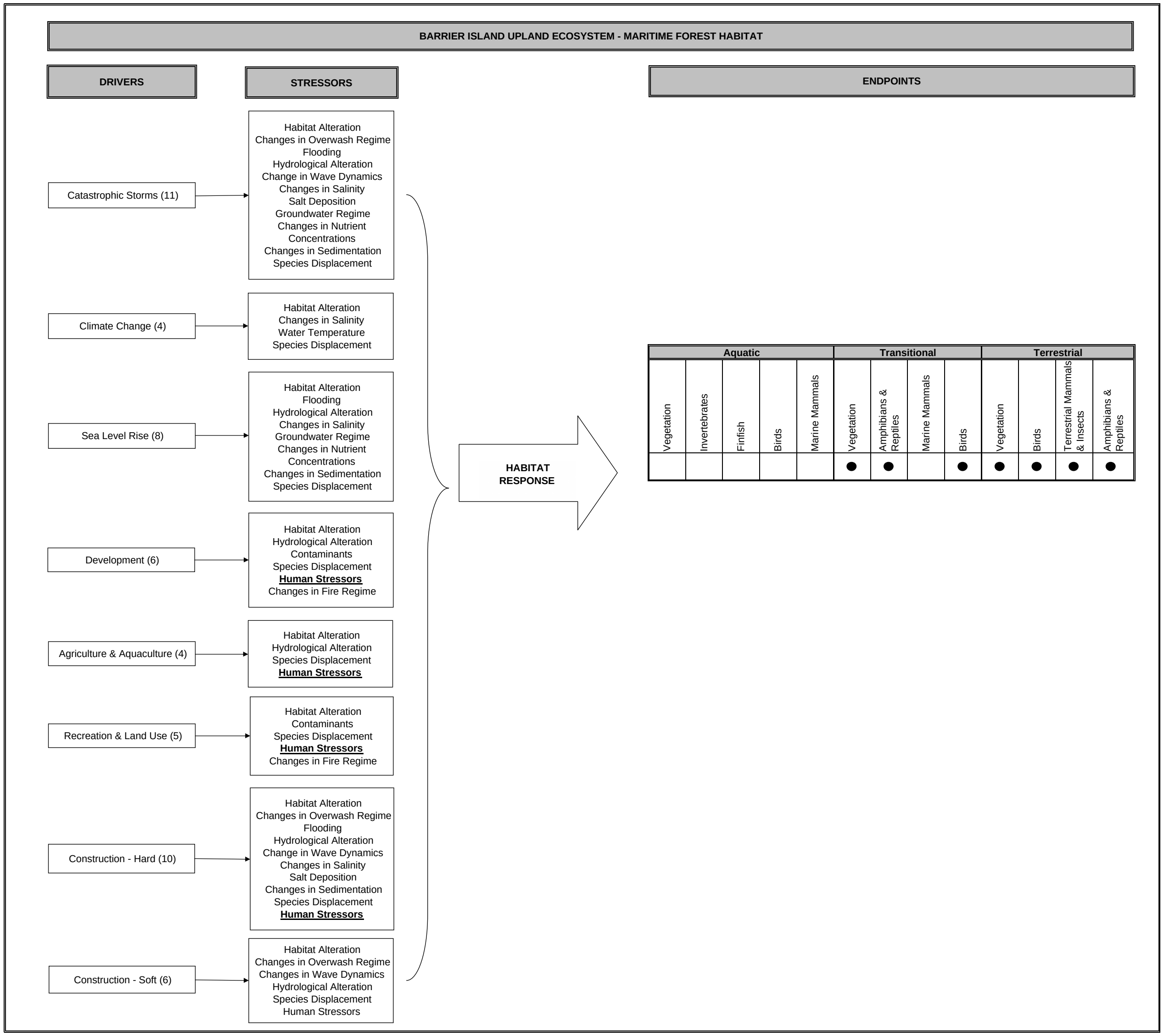
Figure A16
Barrier Island Upland Ecosystem - Bayside Beach Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
	●					●		●		●	●	●

Note: Numbers in parentheses indicate the number of stressors associated with that driver;Stressors that appear in underlined bold indicate that all stressors in

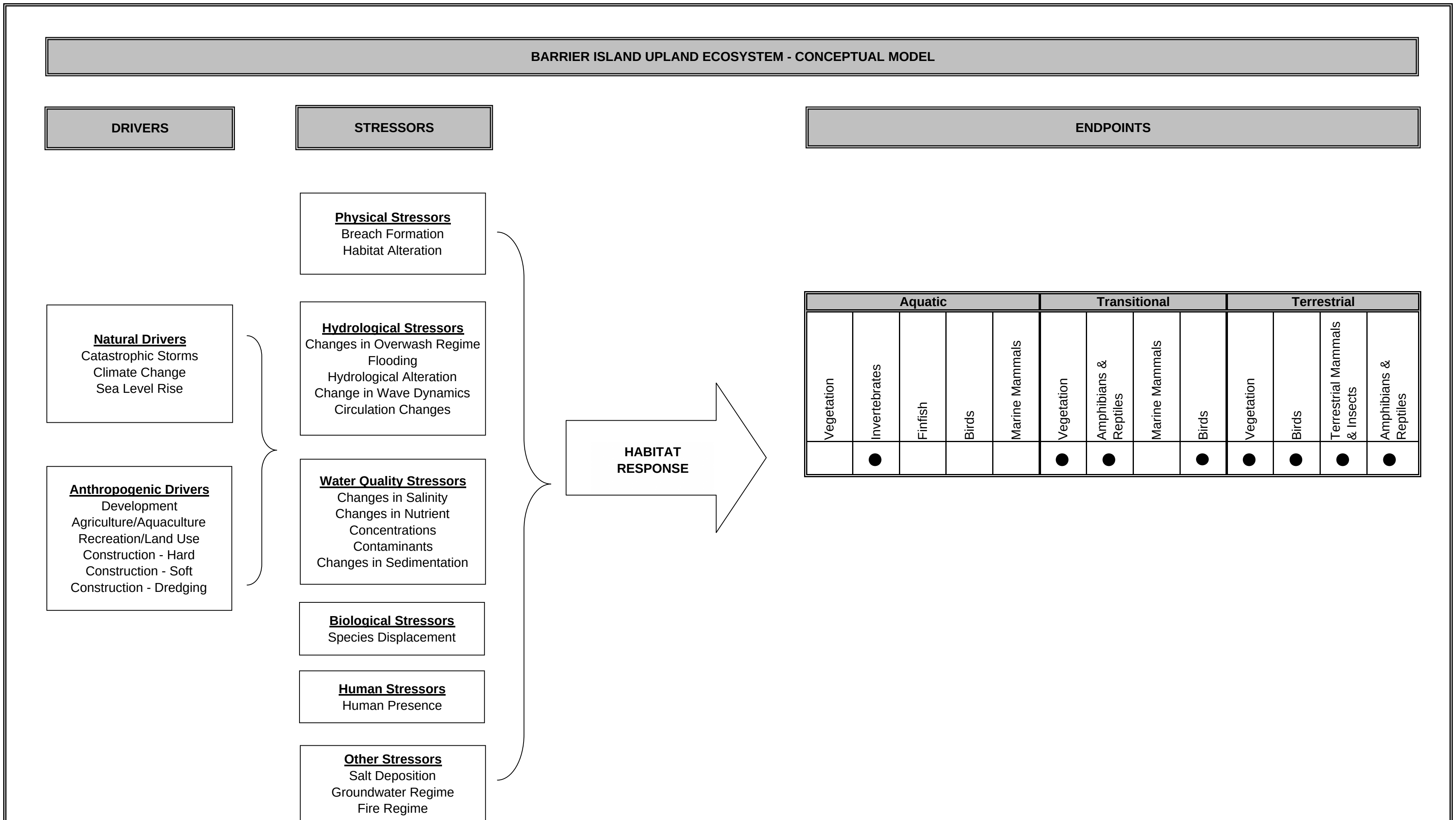
Figure A17
Barrier Island Upland Ecosystem - Maritime Forest Habitat
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point



Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
					●	●		●	●	●	●	●

Note: Numbers in parentheses indicate the number of stressors associated with that driver.
Stressors that appear in underlined bold indicate that all stressors in that category apply.

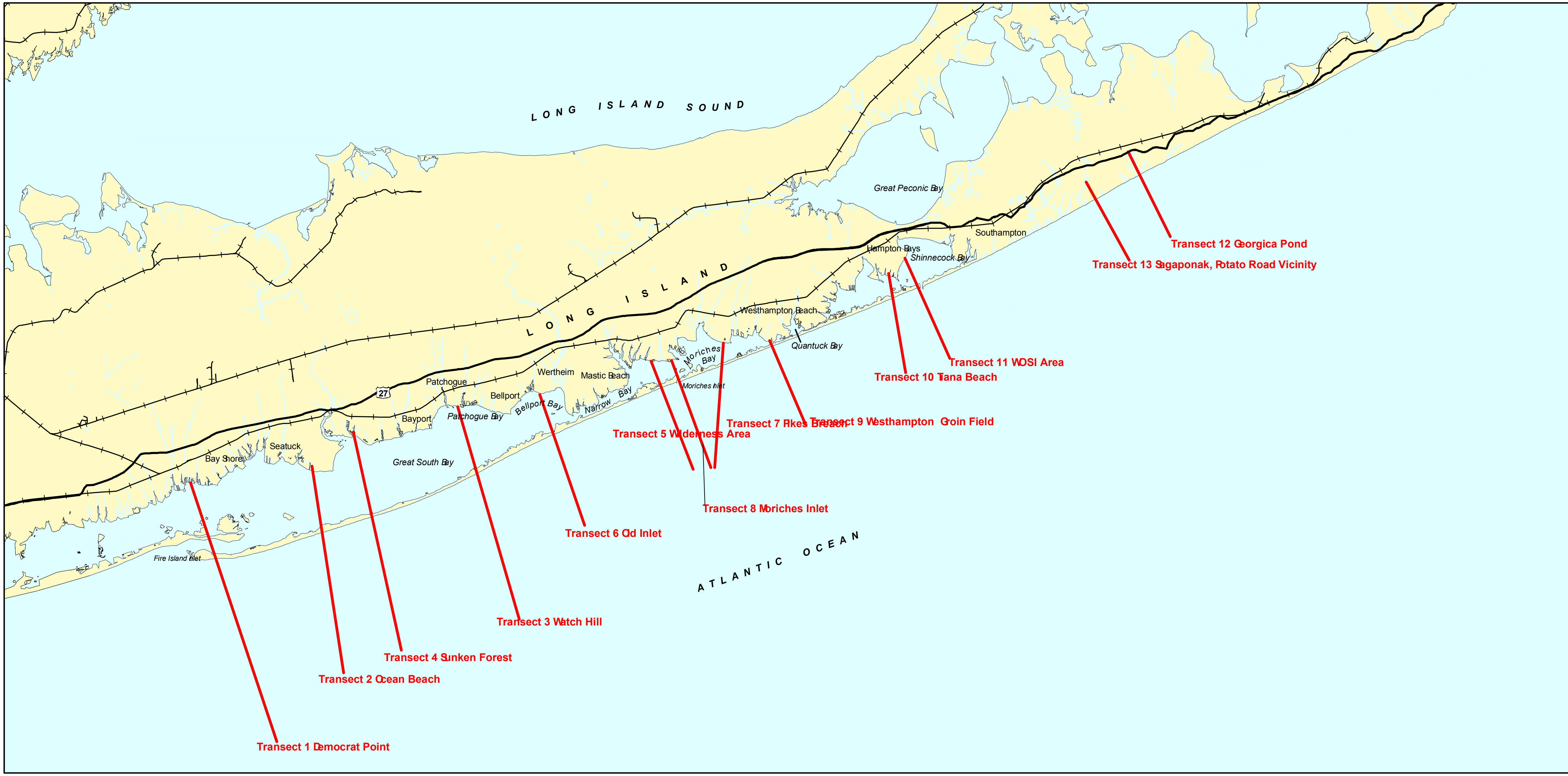
Figure A18
Barrier Island Upland Ecosystem - Conceptual Model
Phase 2 Conceptual Model
Fire Island Inlet to Montauk Point

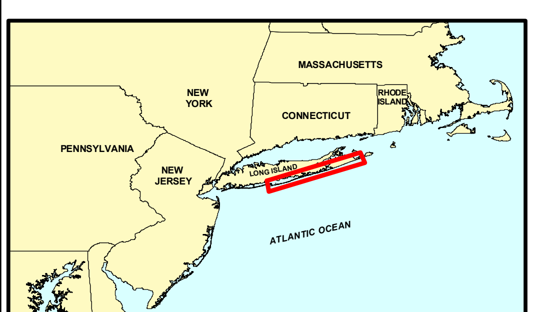


Aquatic					Transitional				Terrestrial			
Vegetation	Invertebrates	Finfish	Birds	Marine Mammals	Vegetation	Amphibians & Reptiles	Marine Mammals	Birds	Vegetation	Birds	Terrestrial Mammals & Insects	Amphibians & Reptiles
	●				●	●		●	●	●	●	●

Note: Numbers in parentheses indicate the number of stressors associated with that driver;Stressors that appear in underlined bold indicate that all

Appendix B
Idealized Transects





Profile View Transect Legend

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Dune/Swale/Disturbed
- Mixed Vegetation/Phragmites
- Maritime Forest
- Upland Terrestrial
- Disturbed
- Salt Marsh
- Intertidal Bay/Sand Shoal/Mudflat
- Intertidal Bay/Open Water
- Subtidal Bay/Open Water
- Subtidal Bay/Submerged Aquatic Vegetation
- Coastal Pond
- Fresh Water Wetland
- Inlet

N

4 2 0 4 8

Miles

Horizontal Datum: NAD 83, UTM Meters

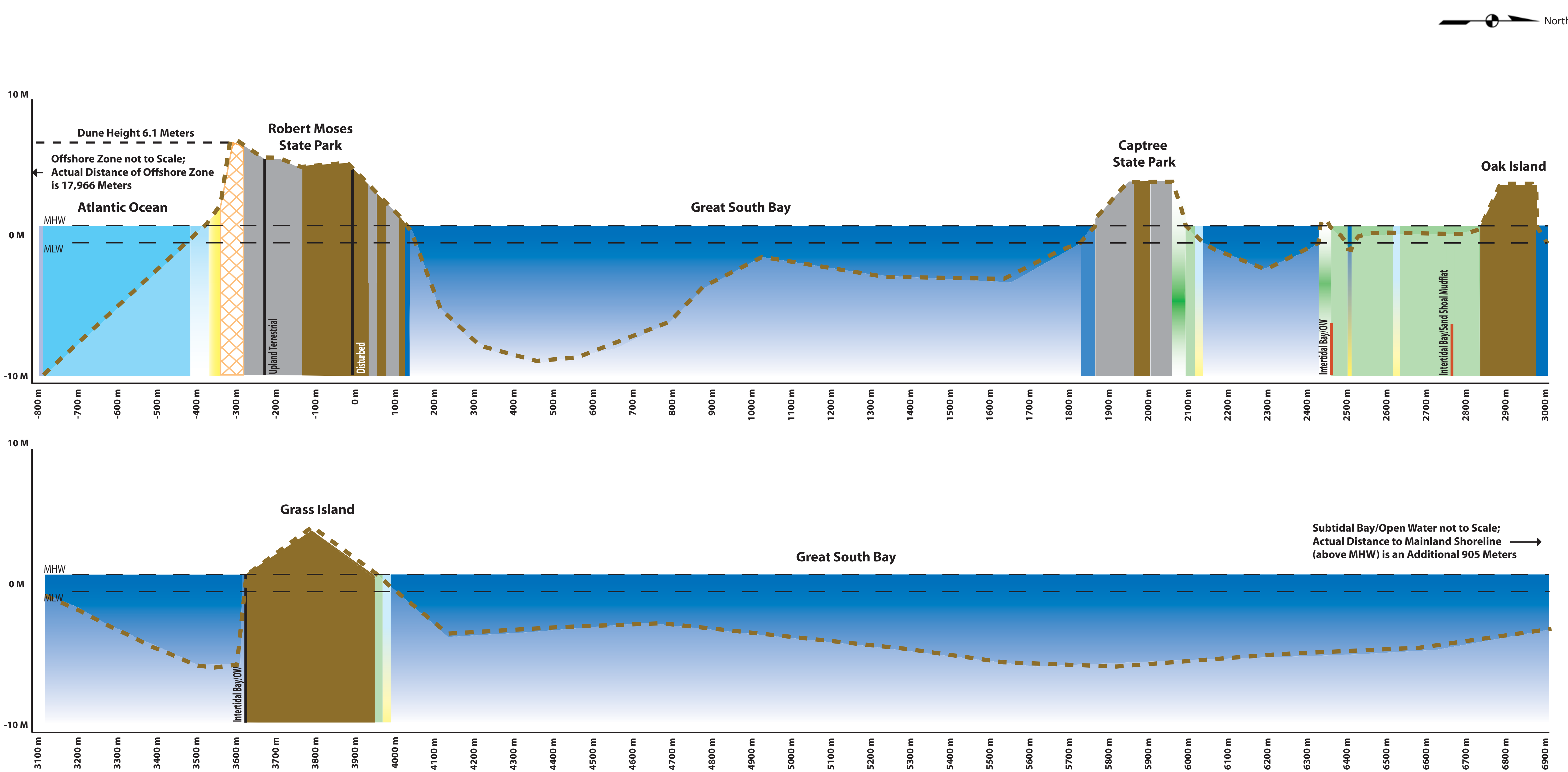
Vertical Datum: NGVD 29

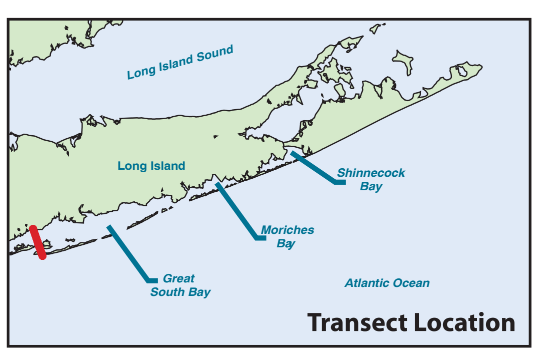
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NY 10278

TRANSECT LOCATION INDEX

FINAL PHASE II COVER TYPE MAP FOR THE CONCEPTUAL MODEL FIRE ISLAND INLET TO MONTAUK POINT REFORMULATION STUDY.

DATE:	FILE NAME:	
07/05	Z:/PROJECTS/CS300-DO32/INDEX.MXD	INDEX





Approximate Horizontal Scale 1 cm = 100 meters

LEGEND

| Cover Type Less Than 10 Meters in Width

- - - Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Mixed Vegetation/Phragmites
- and | Upland Terrestrial
- and | Disturbed
- Salt Marsh
- and | Intertidal Bay/Sand Shoal/Mudflat
- and | Intertidal Bay/Open Water
- Subtidal Bay/Open Water

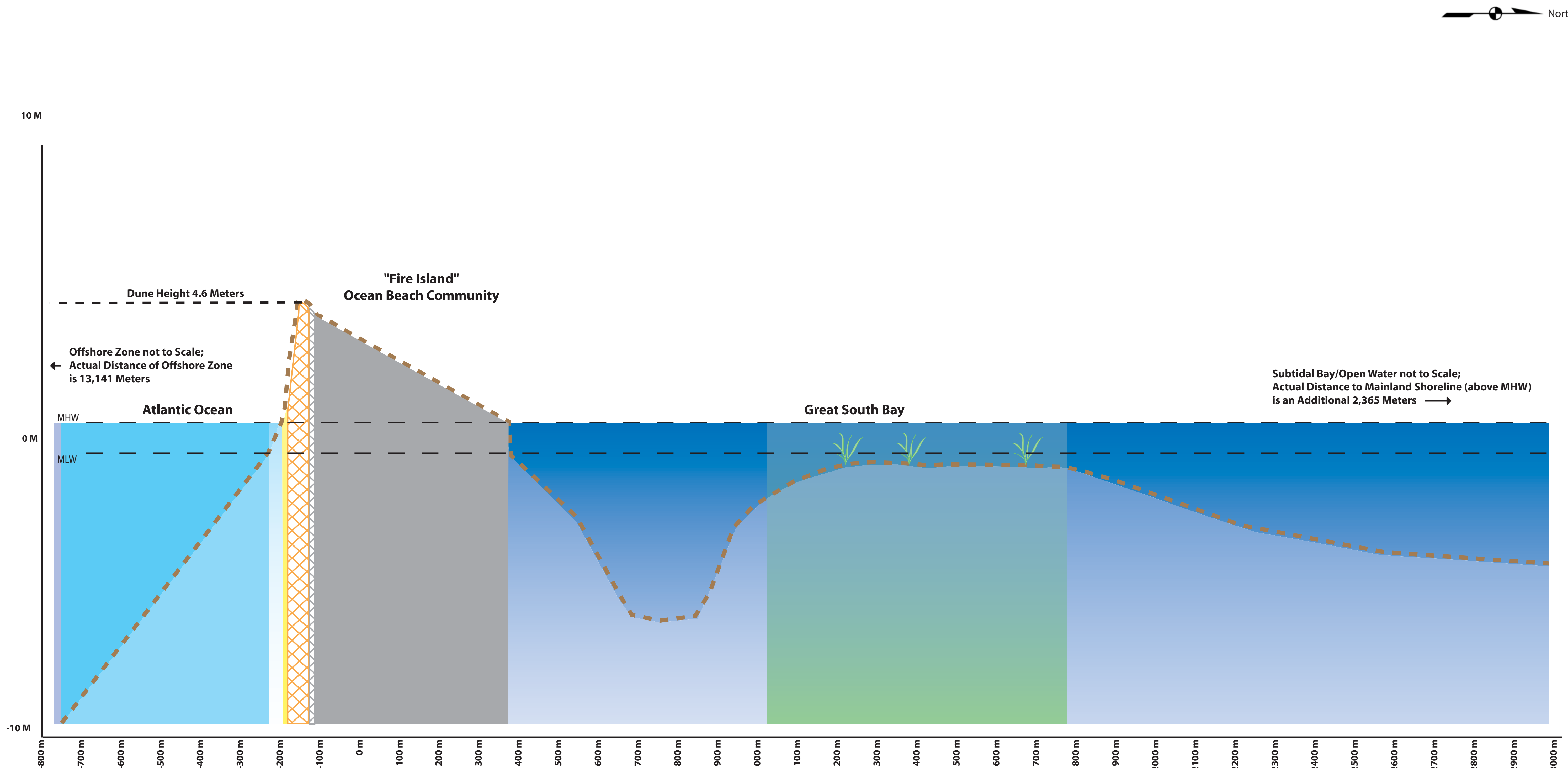
Conceptual Models for Coastal Long Island Ecosystems: Fire Island Inlet to Montauk Point Reformulation Study

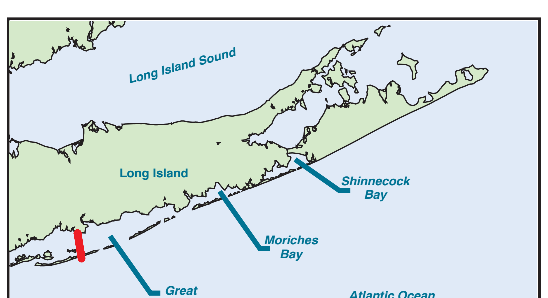
IDEALIZED TRANSECT 1- PROFILE VIEW THROUGH DEMOCRAT POINT

U.S. Army Corps of Engineers
New York District

Map No.T1

Date: 01/28/05





Transect Location

Approximate Horizontal Scale 1 cm = 100 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Disturbed
- Disturbed
- Subtidal Bay/Open Water
- Subtidal Bay/Submerged Aquatic Vegetation

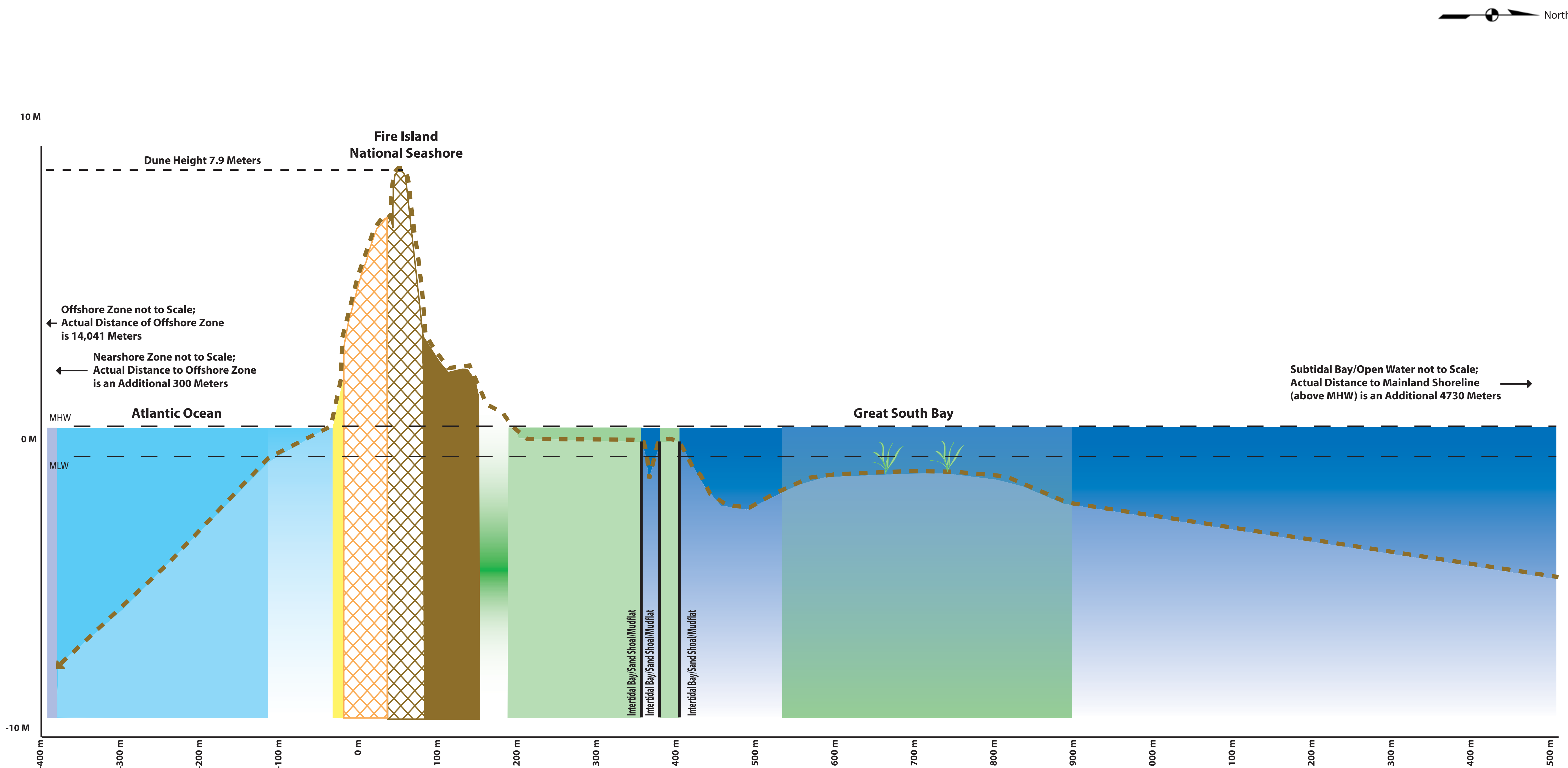
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

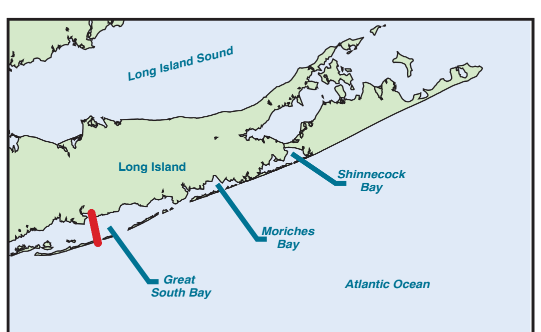
IDEALIZED TRANSECT 2 - PROFILE VIEW
THROUGH OCEAN BEACH

U.S. Army Corps of Engineers
New York District

Map No. T2

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

- | Cover Type Less Than 10 Meters in Width
- - - Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Mixed Vegetation/Phragmites
- Upland Terrestrial
- Salt Marsh
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water
- Subtidal Bay/Submerged Aquatic Vegetation

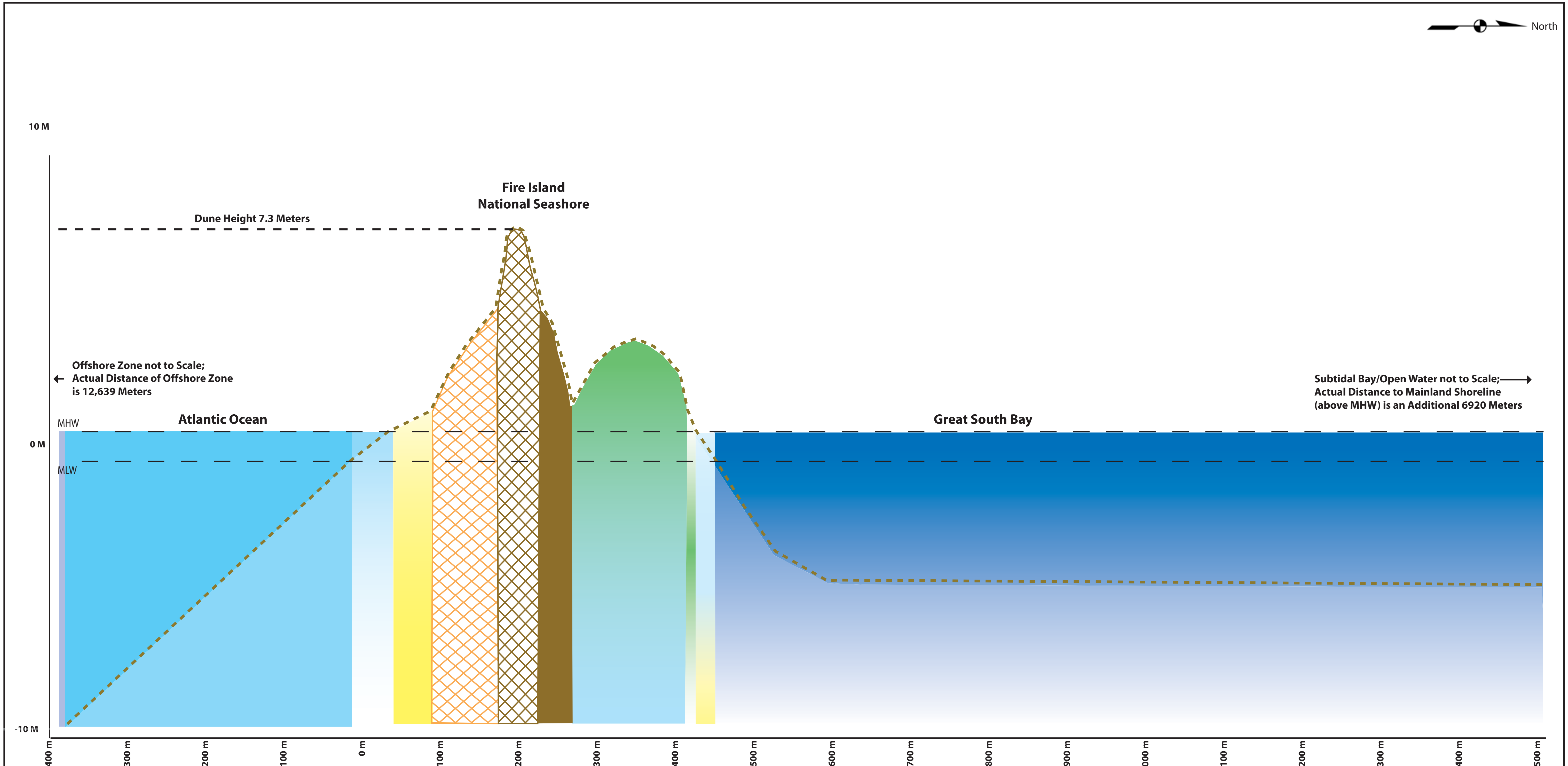
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

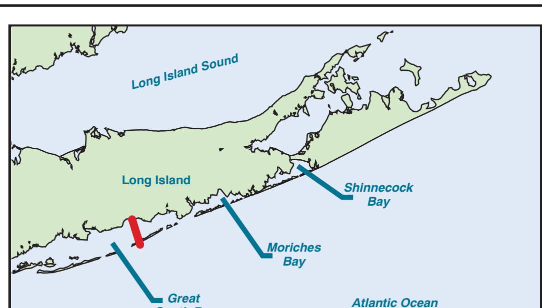
IDEALIZED TRANSECT 3 - PROFILE VIEW
THROUGH WATCH HILL

U.S. Army Corps of Engineers
New York District

Map No.T3

Date: 01/28/05





Transect Location

Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Mixed Vegetation/Phragmites
- Upland Terrestrial
- Maritime Forest
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water

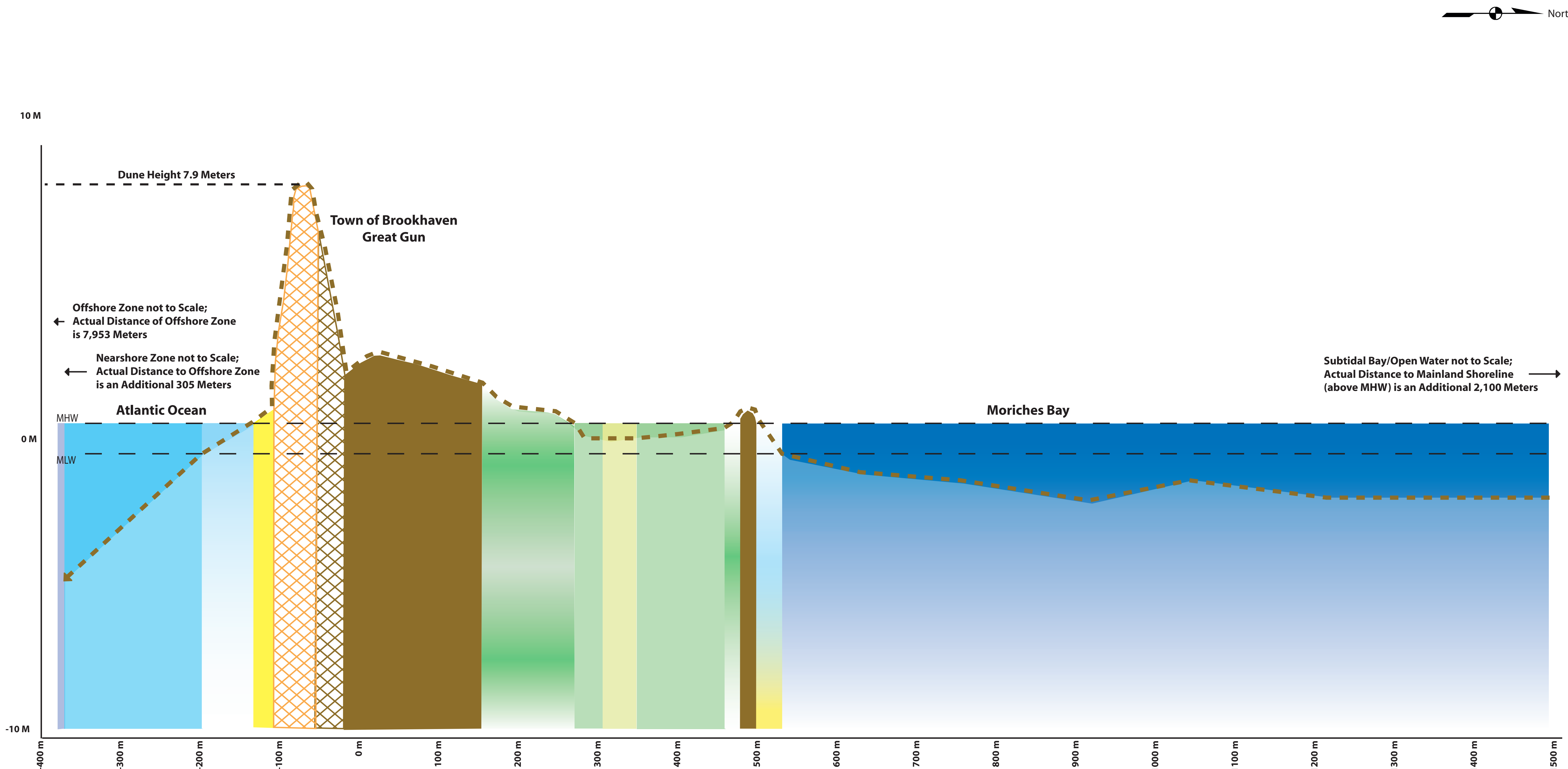
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

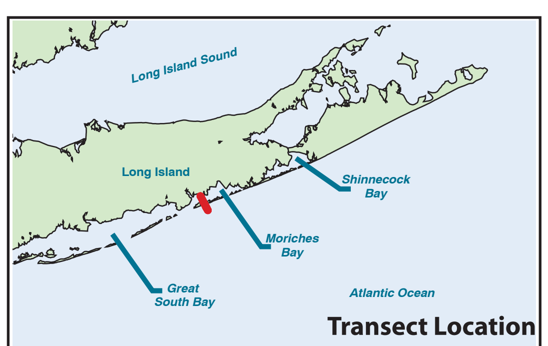
IDEALIZED TRANSECT 4 - PROFILE VIEW
THROUGH SUNKEN FOREST

U.S. Army Corps of Engineers
New York District

Map No.T4

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

- Bottom Contour (Surface Water Depths are Approximate)
- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Mixed Vegetation/Phragmites
- Upland Terrestrial
- Salt Marsh
- Coastal Pond
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water

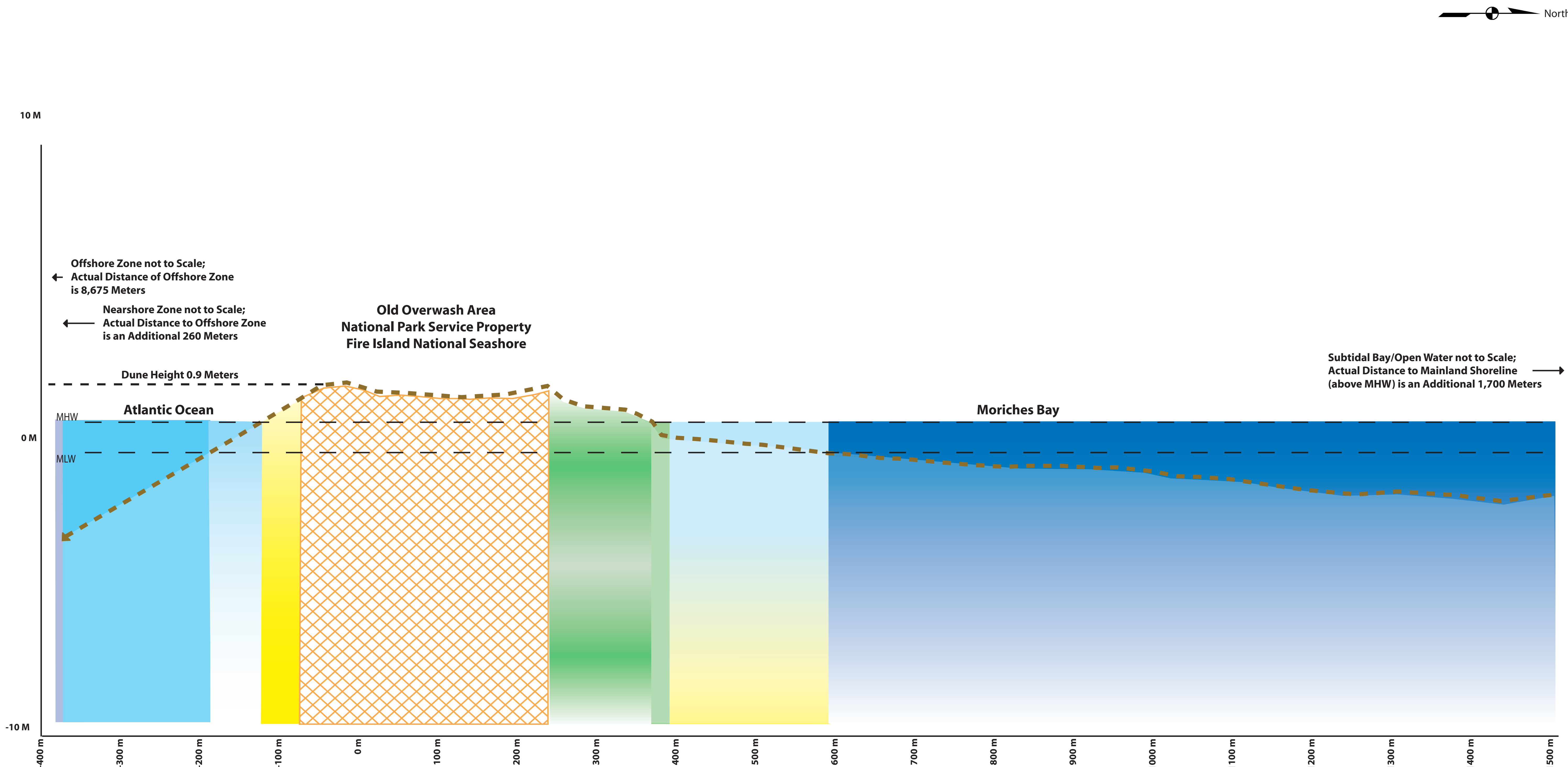
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

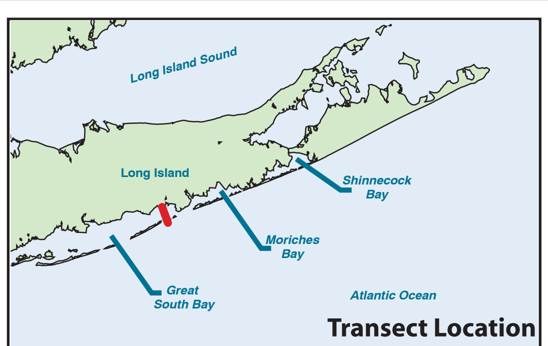
IDEALIZED TRANSECT 5 - PROFILE VIEW
THROUGH WILDERNESS AREA

U.S. Army Corps of Engineers
New York District

Map No.T5

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

- Bottom Contour (Surface Water Depths are Approximate)
- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Mixed Vegetation/Phragmites
- Salt Marsh
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water

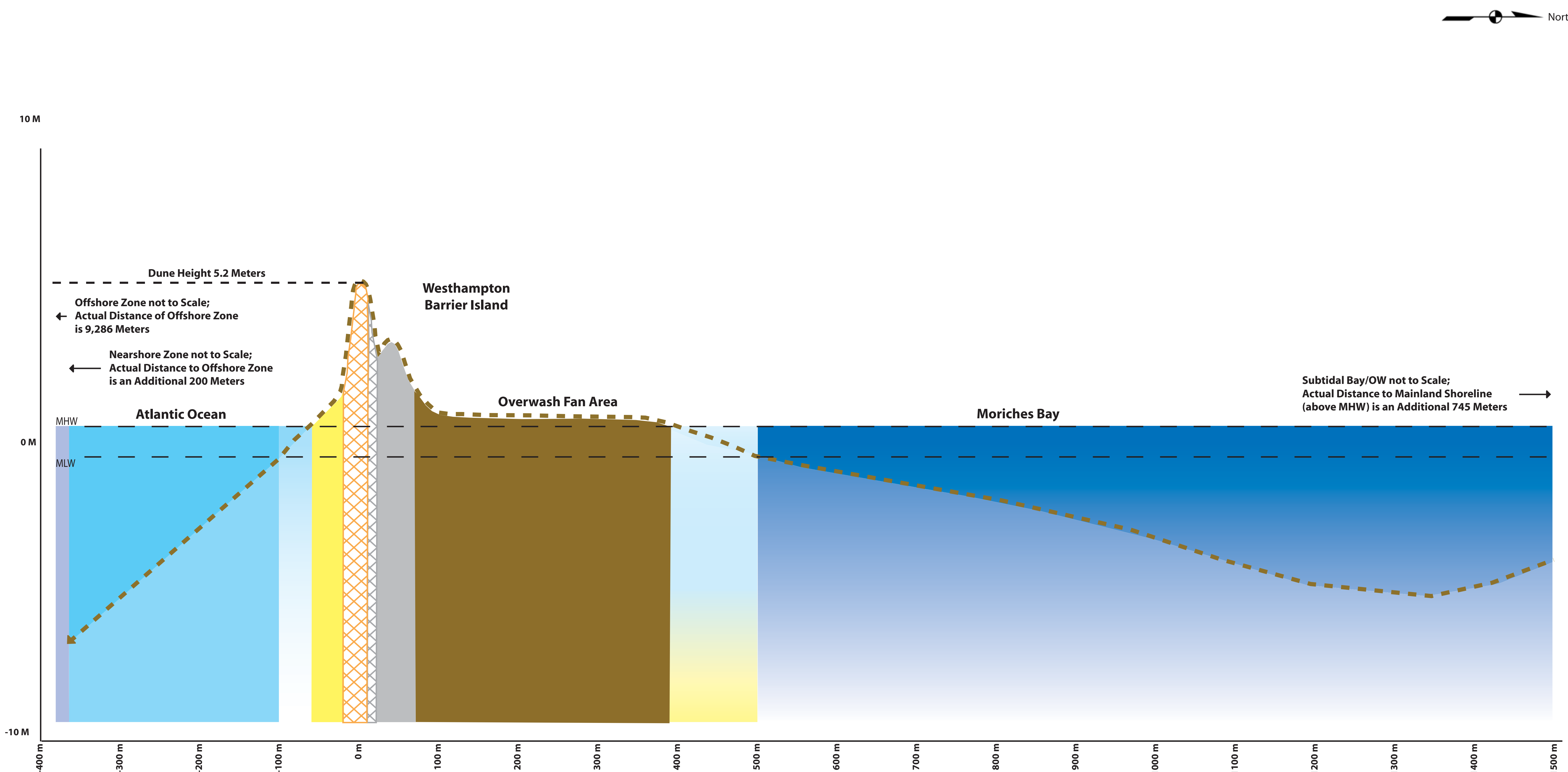
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

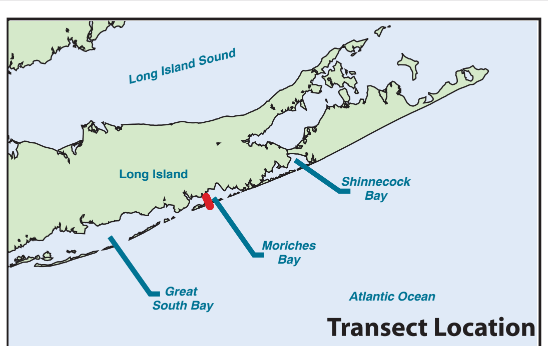
IDEALIZED TRANSECT 6 - PROFILE VIEW
THROUGH OLD INLET

U.S. Army Corps of Engineers
New York District

Map No.T6

Date: 01/28/05





Transect Location

Approximate Horizontal Scale 1 cm = 100 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Disturbed
- Upland Terrestrial
- Disturbed
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water

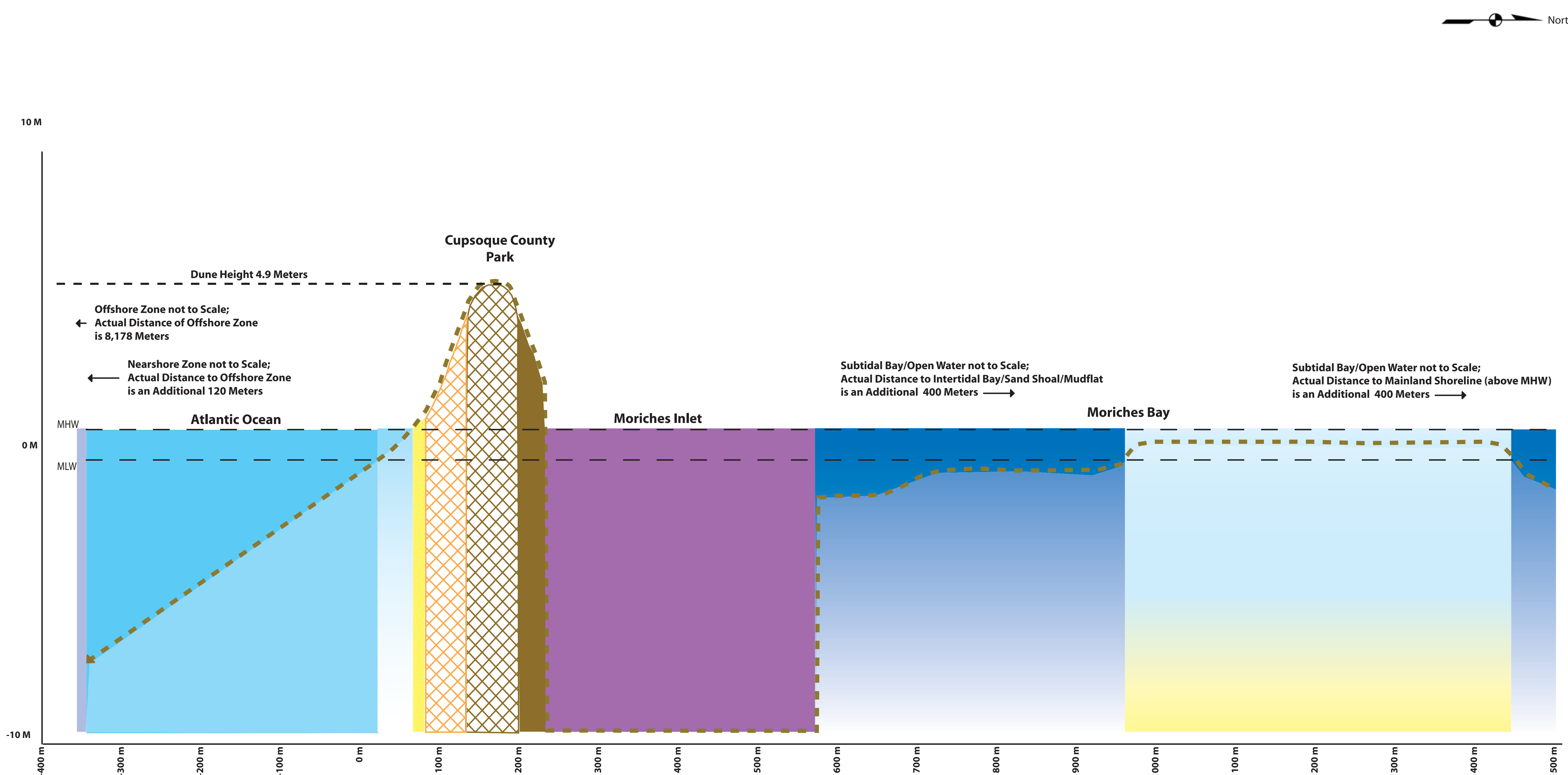
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

IDEALIZED TRANSECT 7 - PROFILE VIEW
THROUGH PIKES BREACH

U.S. Army Corps of Engineers
New York District

Map No.T7

Date: 01/28/05



Transect Location

Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

- - - Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Upland Terrestrial
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Watwr
- Inlet

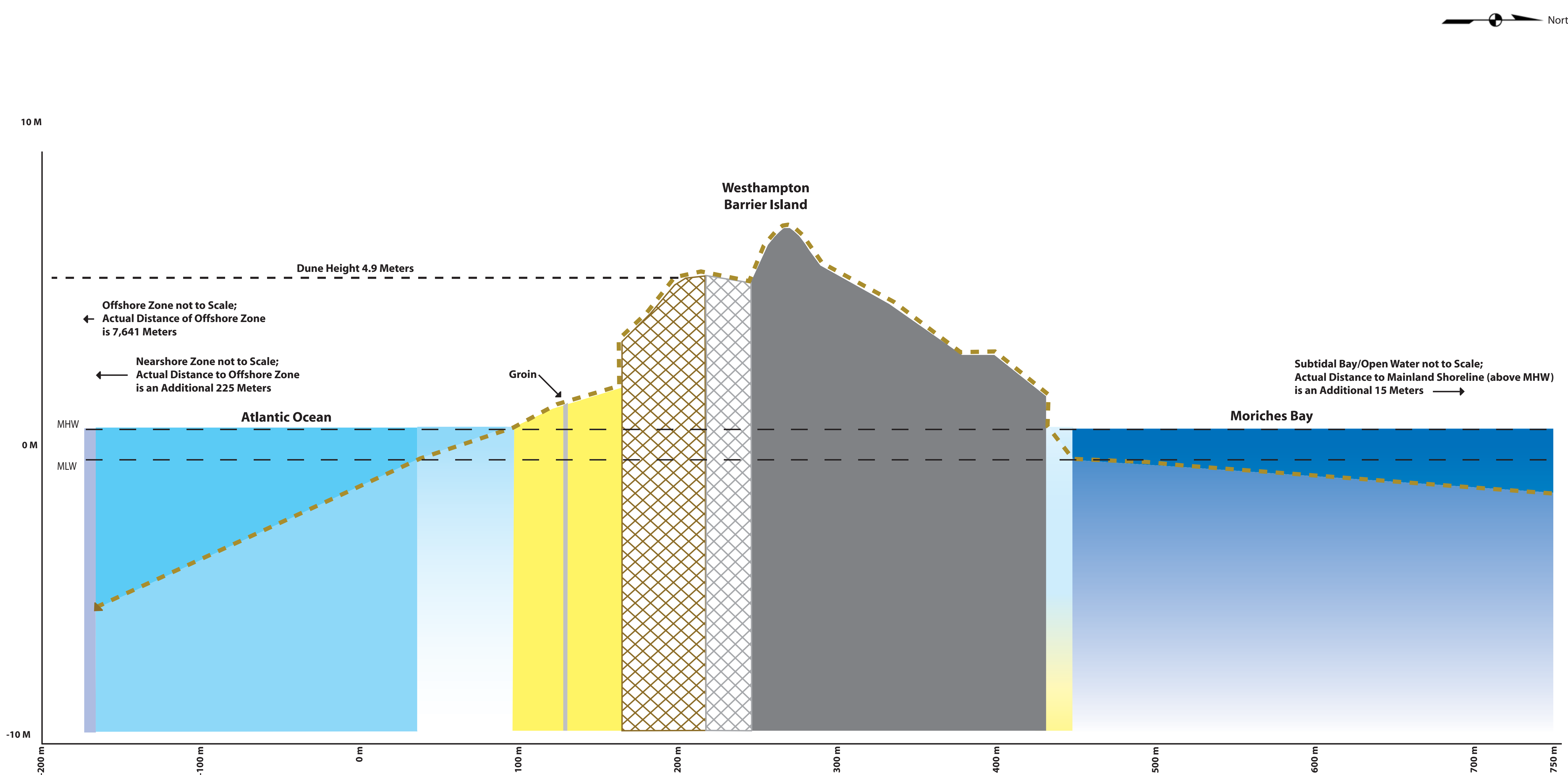
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

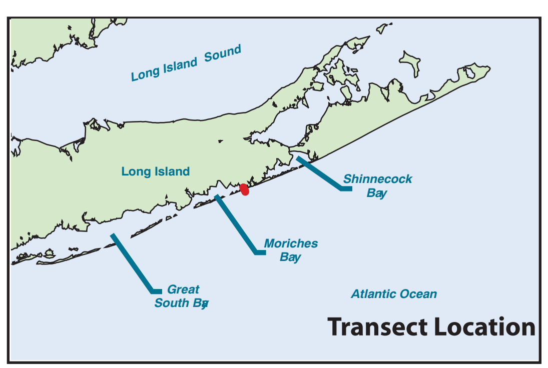
IDEALIZED TRANSECT 8 - PROFILE VIEW
THROUGH MORICHES INLET

U.S. Army Corps of Engineers
New York District

Map No.T8

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 25 meters

LEGEND

- Bottom Contour (Surface Water Depths are Approximate)
- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale/Upland Terrestrial
- Dune/Swale/Disturbed
- Disturbed
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water

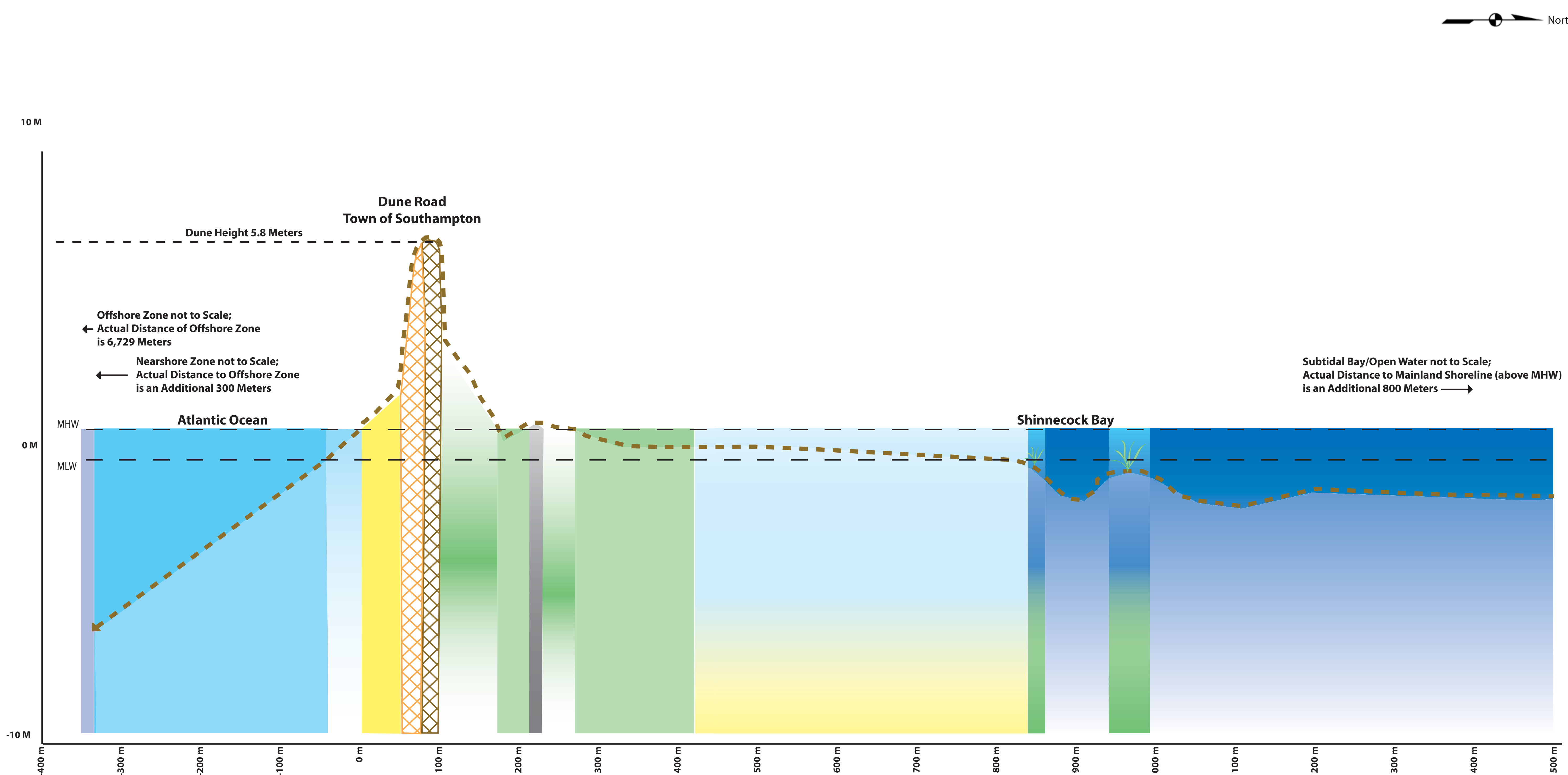
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

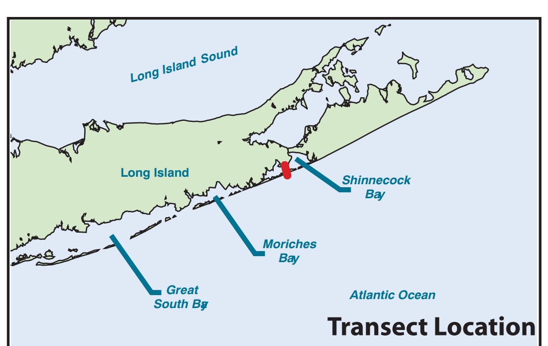
IDEALIZED TRANSECT 9 - PROFILE VIEW
THROUGH WESTHAMPTON GROIN FIELD

U.S. Army Corps of Engineers
New York District

Map No.T9

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Mixed Vegetation/Phragmites
- Disturbed
- Salt Marsh
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water
- Subtidal Bay/Submerged Aquatic Vegetation

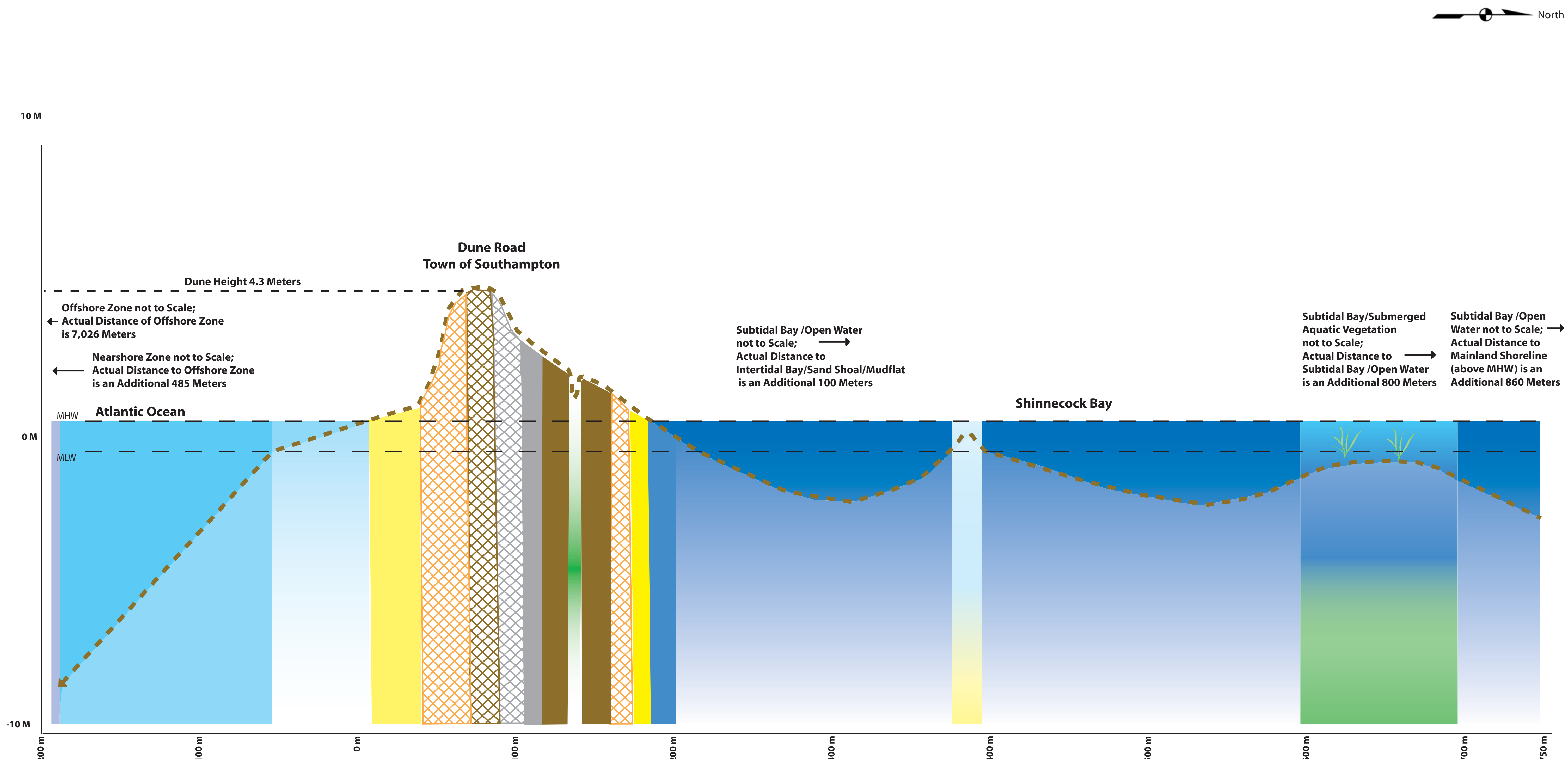
Conceptual Models for Coastal Long Island Ecosystems: Fire Island Inlet to Montauk Point Reformulation Study

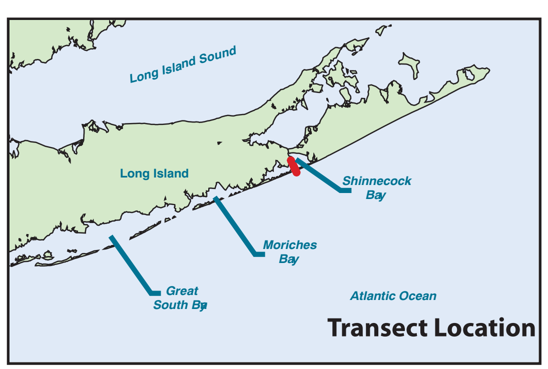
IDEALIZED TRANSECT 10 - PROFILE VIEW THROUGH TIANA BEACH

U.S. Army Corps of Engineers
New York District

Map No.T10

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 25 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Dune/Swale/Disturbed
- Mixed Vegetation/Phragmites
- Upland Terrestrial
- Disturbed
- Intertidal Bay/Open Water
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water
- Subtidal Bay/Submerged Aquatic Vegetation

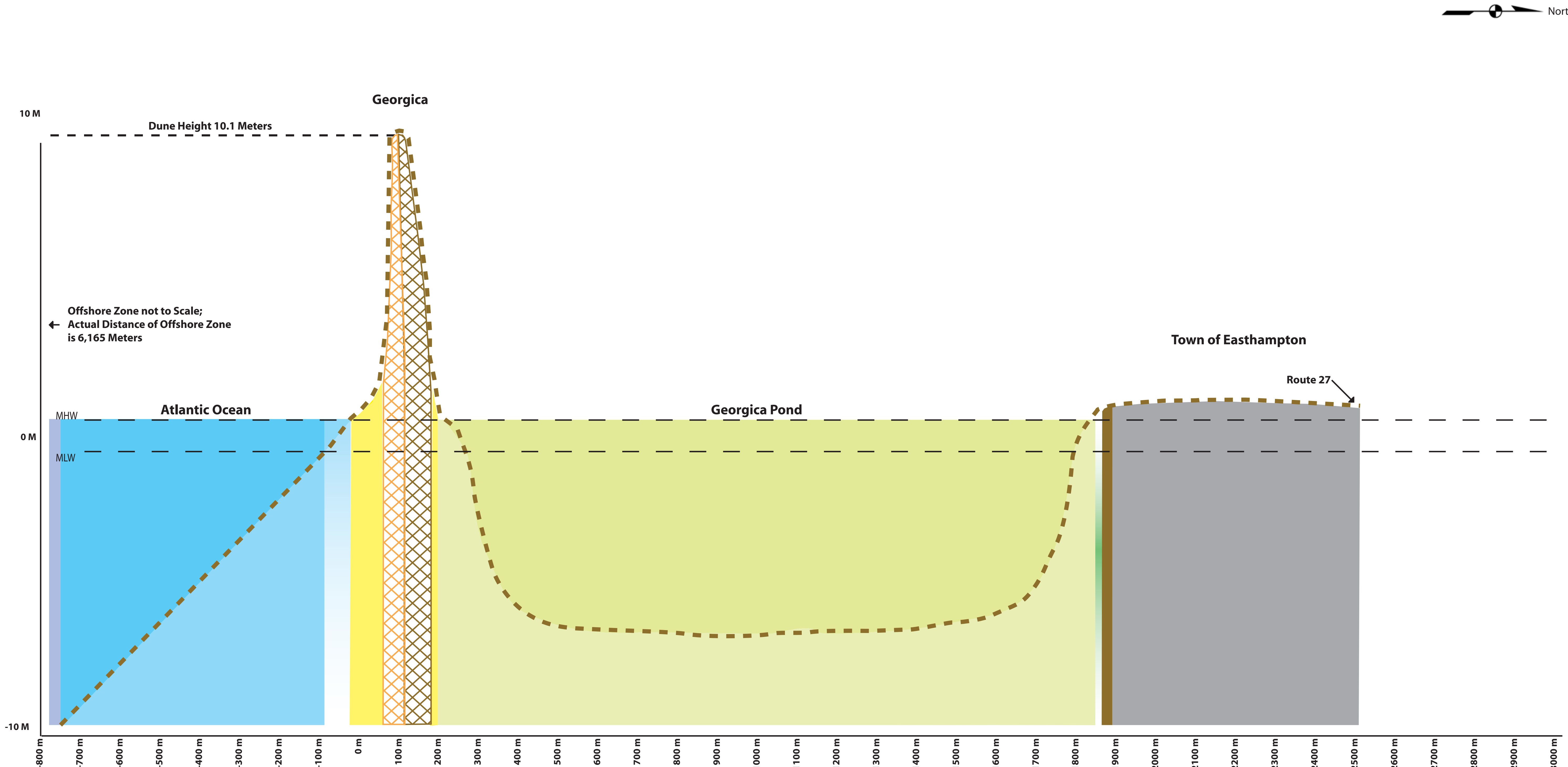
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

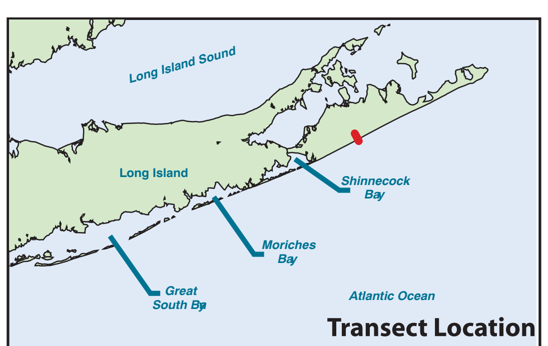
IDEALIZED TRANSECT 11 - PROFILE VIEW
THROUGH WOSI AREA

U.S. Army Corps of Engineers
New York District

Map No.T11

Date: 01/28/05





Approximate Horizontal Scale 1 cm = 100 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale
- Dune/Swale/Upland Terrestrial
- Mixed Vegetation/Phragmites
- Upland Terrestrial
- Disturbed
- Coastal Pond
- Intertidal Bay/Sand Shoal/Mudflat
- Subtidal Bay/Open Water

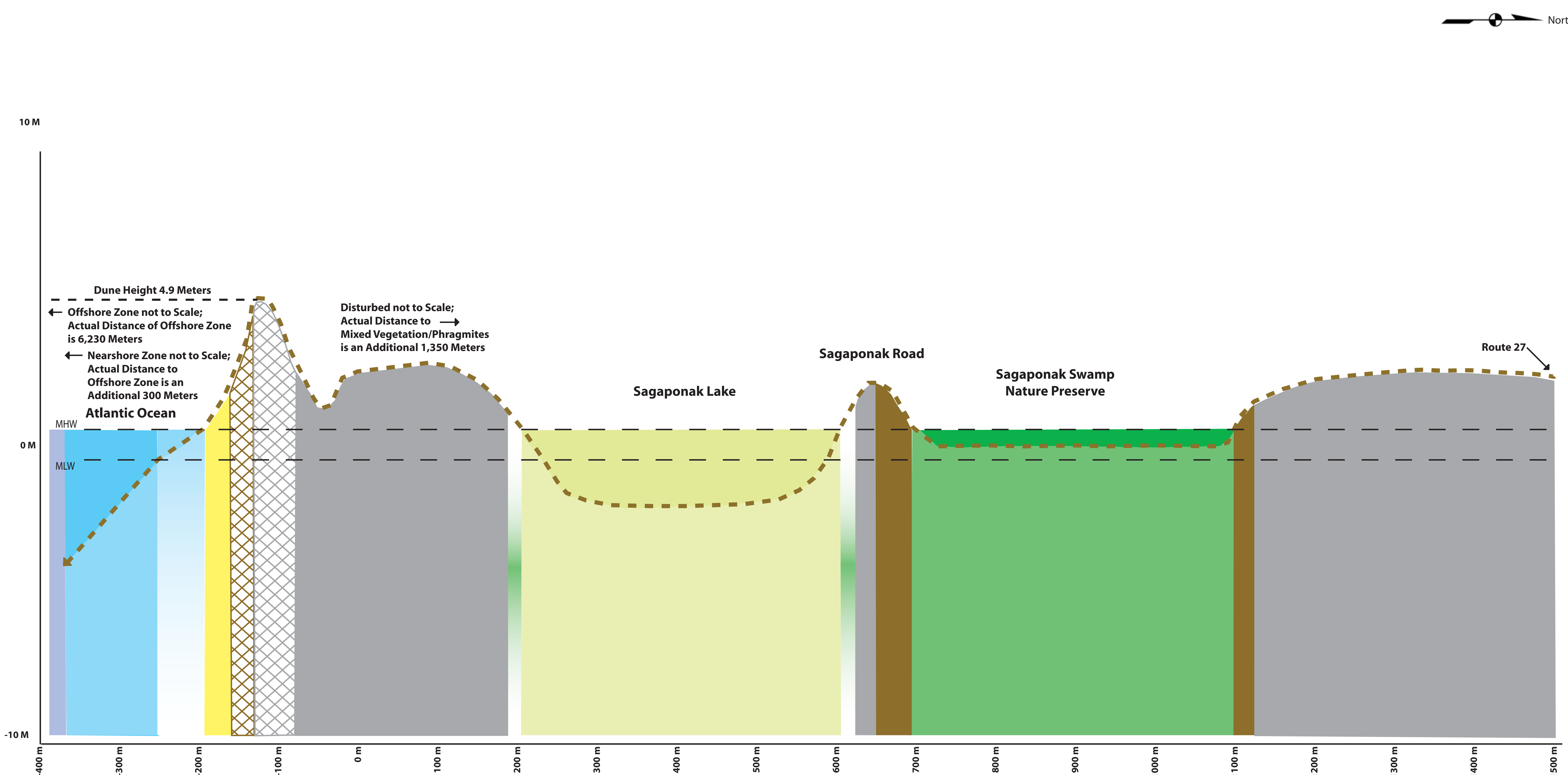
Conceptual Models for Coastal Long Island Ecosystems:
Fire Island Inlet to Montauk Point Reformulation Study

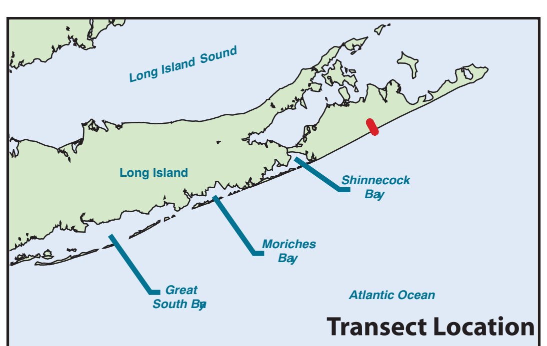
IDEALIZED TRANSECT 12 - PROFILE VIEW
THROUGH GEORGICA POND

U.S. Army Corps of Engineers
New York District

Map No.T12

Date: 01/28/05





Transect Location

Approximate Horizontal Scale 1 cm = 50 meters

LEGEND

Bottom Contour (Surface Water Depths are Approximate)

- Offshore (from 10 m depth to 30 m depth)
- Nearshore (to a depth of 10 m)
- Sandy Intertidal Ocean
- Sandy Beach
- Dune/Swale/Upland Terrestrial
- Dune/Swale/Disturbed
- Mixed Vegetation/Phragmites
- Upland Terrestrial
- Disturbed
- Coastal Pond
- Fresh Water Wetland

Conceptual Models for Coastal Long Island Ecosystems: Fire Island Inlet to Montauk Point Reformulation Study

IDEALIZED TRANSECT 13 - PROFILE VIEW THROUGH SAGAPONAK, POTATO ROAD VICINITY

U.S. Army Corps of Engineers
New York District

Map No.T13

Date: 01/28/05